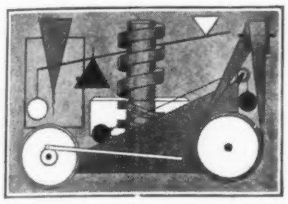
MACHINE DESIGN

as it affects

ENGINEERING-PRODUCTION-SALES

Volume 4 **April, 1932** **Number 4**



Next MONTH

CONSIDERABLE interest and discussion having been aroused by H. F. Shepherd's article "Shaft Deflection and Its Influence on Bearing Design" which appeared in the January issue, it is planned to publish another contribution on the same subject next month.

This article presents as its principal aim the method of determining the deflection through bearings and the reactions of the bearings when double supports are used. It should prove to be not only timely but extremely valuable.

L. E. Jermy

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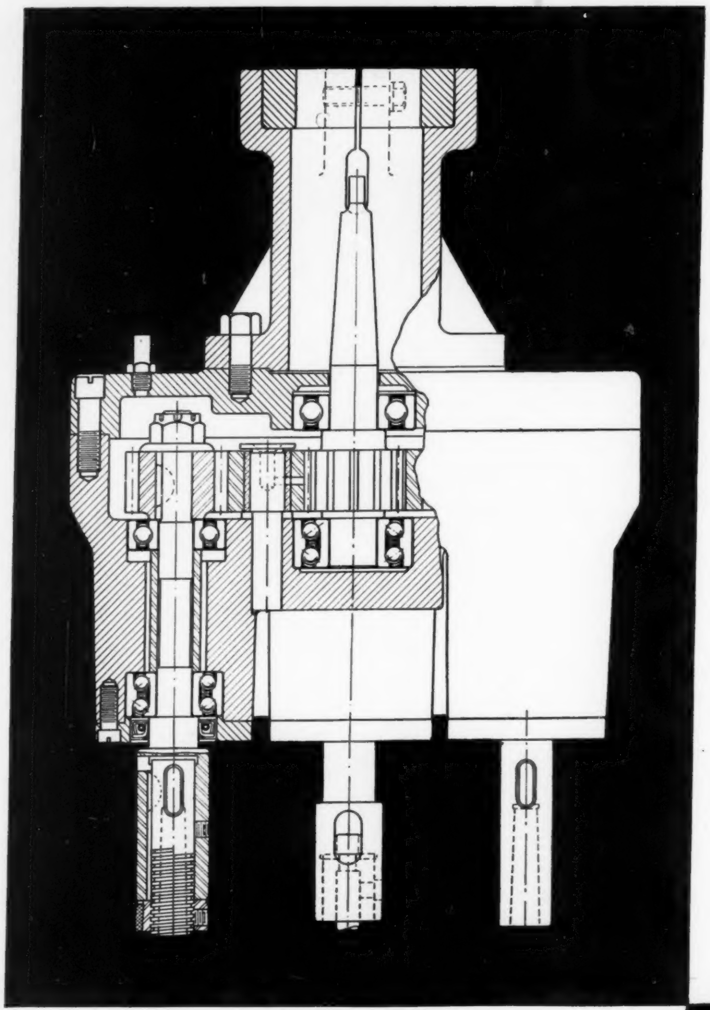
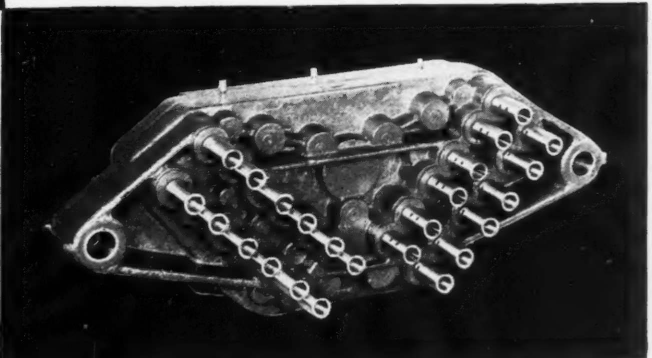
Published on the tenth of each month. Subscription rates: U. S. and Possessions, two years \$5; one year \$3. Single copies, 35 cents. Canada, two years \$6; one year \$3.50, including duty. Europe, two years £2; one year £1.4.0.

THE JOHNSON PUBLISHING CO., PENTON BUILDING, CLEVELAND, OHIO

Affiliated with The Penton Publishing Co.



INSIDE FACTS
on a successful
Drill Head



THE F. Joseph Lamb Company, of Detroit, specialize in the building of drill heads. Here is a type of equipment which demands both accuracy and ruggedness. This makes New Departure Ball Bearings the logical choice. The spindle mounting is especially commendable with its Double Row—Single Row bearing combination. Lag and looseness are impossible because the Double Row has no end-play---is preloaded at the factory. Furthermore, it is a very efficient thrust carrier. New Departures save power, prevent wear and demand little attention. » » Many companies have attained lower production costs and higher machine efficiency by combining their ideas with those of the New Departure engineering personnel. This service is yours, for the asking.

New Departure Ball Bearings

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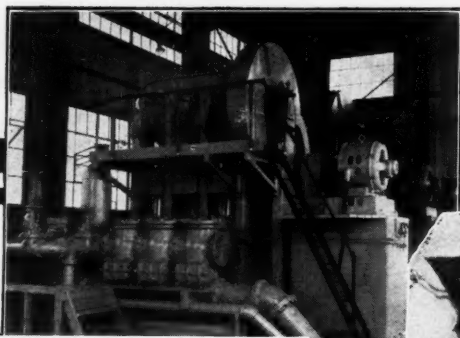
Itemized Index for April, 1932

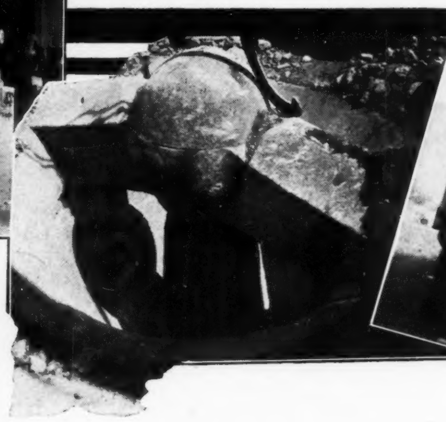
Key: Edit, Editorial Pages; Adv, Advertising Pages; R, Right hand column; L, Left hand column

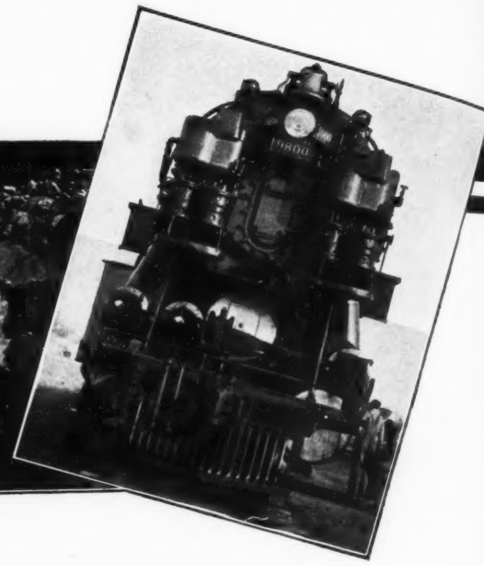
Compiled for the assistance of engineers confronted with specific design problems

"THE other day a man wrote in about the trouble he was having with the cast steel frames of stone crushers breaking and asked if these parts could not be made of rolled steel. Looking through the itemized index to Volume III of Machine Design under 'Welded Parts' the exact solution to this problem was found in the form of an advertisement in the June 1931 issue by Lukenweld. The inquirer was advised to write to this company."

—From a letter received from one of our readers.







MACHINE DESIGN

THE JOHNSON PUBLISHING COMPANY, CLEVELAND, OHIO

April, 1932 Vol. 4—No. 4

Do Designers Give Sufficient Thought to Production?

By L. E. Jermy
Editor, Machine Design

FROM the tone of the letters received from designing engineers expressing their views of production departments it is evident that they are only mildly critical of what goes on in the plant under the direction of the shop superintendent. Perhaps the absence of vehement complaint is due to the fact that the majority of engineers have a pretty fair understanding of the daily problems confronted by the men in the shops. Certainly the average designer finds it easier to appreciate the viewpoint of the shop superintendent than that of the sales manager, the purchasing agent, or of other department heads with whom he comes in contact. One reason for this is that the design and shop forces are thrown together many times in the course of a day's routine whereas the occasions requiring consultation with sales, purchasing and other departments are less frequent. An engineer cannot spend many hours going over the details of a blueprint with a shop superintendent without learning much about his problems.

IN the March issue a group of shop superintendents set forth their opinions on the shortcomings of design engineers. The burden of their criticism was that designers are prone to underrate the importance of production, are not practical minded, and are too unyielding in their demands upon the shop.

The designers offer their rebuttal in this issue. They emphasize the shop man's reluctance to depart from traditional methods and his readiness to declare a proposed job cannot be done.

Fortunately the gap between the two viewpoints is not wide. If mutual confidence exists, the danger of serious discord is remote. —The Editors

Despite this there are a number of elements of danger in the relations between these two individuals. As will be noted from the accompanying composite letter, the most important cause of discord lies in the age-old conflict between theory and practice. No matter how practical a design engineer may be, in the eyes of the shop man he is a theorist. On the other hand the shop superintendent is a practical man. Whether the teaming of an exponent of theory with an advocate of practical experience makes for weakness or strength depends largely upon the qualities of the two. If one is inclined to discount the ability of the other the clash between theory and practice may be a source of frequent friction and its attendant evils of inefficiency. But if there exists mutual

respect for each other's ability, the shop man's practical judgment becomes a valuable check against the work of the designer and simultaneously the designer's ideas furnish a refreshing current of incentive to spur the production man to greater feats of resourcefulness.

When this condition exists the skill of the shop department may be said to complement and supplement the ability of the design department. Under such favorable auspices, the shop superintendent is not likely to resort to the famous cry, "It can't be done," as readily as do those superintendents mentioned in the accompanying letter. If the spirit of teamwork exists in the degree to which it should, he will exert himself to the limit to find a way to meet any reasonable specification made by the designers in his organization.

It was to be expected that in refuting last month's arguments by shop superintendents, engineers in their letters would refer to the "It can't be done" attitude. Anyone who has had even a casual acquaintance with shop organizations knows how often that phrase is used. Nor is its use confined to the walls of the plant. It is employed lavishly in practically every walk in life.

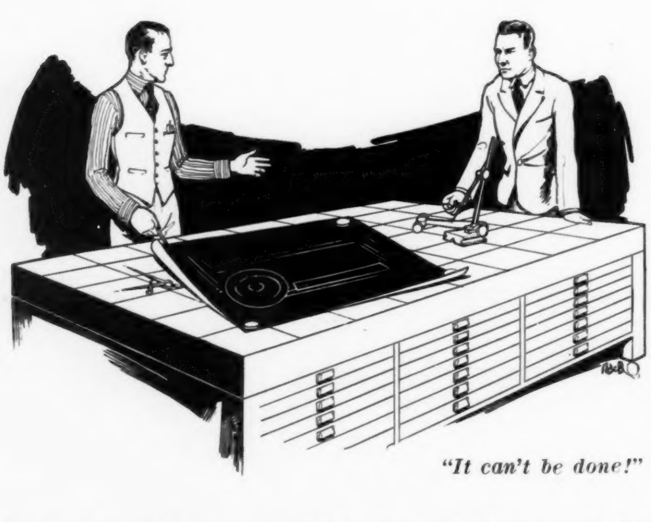
Sometimes a harried shop superintendent is thoroughly justified in saying "It can't be done." The impossible is brought to his door more frequently than is generally known. And when that situation arises, his emphatic statement

How the Designer Regards the Sho

EVERY engineer knows by experience that the chief obstacle to complete understanding between his department and the shop lies in the different attitudes of designers and shop superintendents. Each views a given problem from somewhat divergent angles.

The shop man generally is a very practical man, having risen to his position as foreman or superintendent from the bench or lathe, and while he has thorough knowledge of his work he does not have any training from the design standpoint. Although his position usually is based on his experience, it is not always experience that is appropriate to the understanding of design problems.

As engineers charged with responsibility for design, we witness many cases where a shop man has figured out something by rule of thumb, and because it did not agree with the specifications worked out and laid down by the design department he has insisted that he was right and would not give in until he was forced to do so.



"It can't be done!"

We realize that this is a phase of the ever present conflict between theory and practice. Of course the two do not always agree, but is it not possible that practice may be wrong as well as theory?

An engineer may have carried the solution of a design problem in his mind consciously and subconsciously for weeks, 24 hours a day, and have arrived finally at a plan he considers feasible. The specifications are prepared and turned over to the shop. There it is greeted with the emphatic declaration "It can't be done" or with the judicial remark "It may be all right in theory but it won't work in practice."

The point in dispute may have to do with tolerances, costs, or perhaps an operation not within the experience of the organization. In working out his plan the engineer drew on other people's experience. Why should not the shop people do the same?

For instance, a drawing calling for a tapped hole at an angle to the base was sent to a certain shop superintendent. He made a great fuss about the job. He was sure that every tap in the place would be broken. It happened that the piece was ordered outside from a screw machine company. This firm turned out thousands of the parts and never questioned the angle. Had the superintendent been alive to the necessity of borrowing from the experience of others, he would not have "reared up on his hind legs" when this job came in; he would have accepted the challenge and would have worked it out just as others had done.

In another case a long oil hole was specified in a shaft. The shop let out a loud roar at the difficulties imposed, but tried manfully to lick the job. Finally, after producing a lot of scrap, someone solved the problems of long holes. A little experience borrowed from a nearby gunmaker enabled the shop to go ahead without further difficulty.

A company was confronted with the problem of putting an accurate thread on a spindle for mounting a drill chuck. It was important that the thread be concentric with the ground diameter to give a true running chuck. When the spindle was turned and threaded on a screw machine and then treated and ground the eccentricity was not held within the tolerance demanded. The designer's theory was that the thread should be cut on the same centers used for grinding. The job was then done on a thread miller with satisfactory results. Here was another illustration where practice had been wrong.

serves the useful purpose of curbing the enthusiasm of an over-optimistic designer.

However, in the majority of cases this expression of negation is used to cover a disinclination to depart from long established routine. It takes time, initiative and energy to do a job a new way after it has been done in another way for many years. Shop bosses may have initiative and energy in full measure, yet they always are pressed for time. To do work in the accustomed manner usually is the easiest way out. This accounts for the apparent reluctance to accept new ideas.

Many shop superintendents can be lured into displaying unbelievable feats of resourcefulness if they are handled properly. The writer once knew a general foreman who always boasted he could lick any job that came into his shop. He delighted in awing his associates by accomplishing the seemingly impossible. This trait had been developed by a friendly engineer, who after winning the foreman's respect, gradually furnished him with more difficult problems. The engineers saw to it that the shop and its boss received credit from the management for work well done. Needless to say this foreman was a delight, not only to the design department, but to every department in the company.

This and other experiences leads us to the belief that the prime requisite for smooth teamwork between the design and production departments is mutual confidence.

Superintendent—By a Group of Engineers

In this connection we believe the chiefs of many shop departments are rather slow to accept new shop methods. Some of them actually rebel against changing from traditional practice. Some are prone to follow the path of least resistance. We all recall the gradual rise of autogenous welding and its increasing acceptance by practically all factions of industry, but we also remember that in many cases the shop superintendent was the last to recognize the possibilities of this process. This is true of many methods, materials and parts. The use of new metals such as the recently introduced alloys of steel and aluminum, which alert engineers have been found to recognize and incorporate in their designs, must always be sold to the factory organization before being adopted, due to the different methods employed in heat treating and machining these materials.

The shop man often sticks for a certain kind of material because he has used it during past years, but he does not have any good way of keeping in touch with changes and improvements in materials to the extent that the design department has through its more direct contact with the salesmen and literature from suppliers of materials used in the design of the product.

As engineers who throughout this series of letters in MACHINE DESIGN have read attacks on us from all quarters because we do not give enough attention to what is going on in contemporary fields of design, we now suggest that a similar criticism might be directed to the shop personnel with equal if not greater propriety. Certainly it is true that in many shops the organization is lamentably ignorant of methods that are well known and firmly established as practice in more enterprising establishments.

As a rule superintendents are lax in keeping designers informed on new equipment or new processes available in their shops. Several of us, representing long familiarity with conditions in numerous large and small companies, do not recall ever seeing a communication of any kind from the factory advising engineers that new machines had been installed or that additional equipment or new methods had broadened the facilities of the production department. Of course engineers will learn of new installations sooner or later, but there is no reason why the superintendent should not notify the design department when he adds to the capacity or resourcefulness of his shop. It would help the engineers to utilize the company's facilities more fully and more intelligently.

We are somewhat reluctant to complain about the practice of a very few superintendents of trying to "hang something" on the design department. Our reluctance is due to a knowledge of the shop man's everyday battle with the stores, shipping and other departments—a battle that is bound to make him bend over backward in standing up for his rights. Nevertheless, he sometimes takes advantage of a situation to throw blame on the design department when it really doesn't belong there. This is the old "show 'em up" spirit, and fortunately only a few indulge in it.

At times a superintendent will suggest a change and after the drawing is revised, the specification is used by him as an alibi for a broken shipping date. This usually brings a storm down on the head of the design department.

"Always takes path of least resistance"

The ideal relationship between the design and shop forces calls for consideration on both sides. Sometimes a representative of the engineering department stationed in the shop will help to promote harmony.

SCANNING THE FIELD FOR IDEAS

A Monthly Digest of New Machinery, Materials, Parts and Processes, with Special Attention to Significant Design Features and Trends

Using Refrigerators as Heaters

ENGINEERS are giving serious consideration to the reversed refrigeration cycle for summer and winter air conditioning, practically a virgin field embodying a basic idea for utilizing the refrigerating machine as a heat pump. The condenser in this type of system is the source of heat, and the evaporator the origin of the cooling medium. In such an arrangement is seen one solution to the problem of making a single unit serve the home, office or factory throughout all seasons.

Already one modern office building in California has an air conditioning installation incorporating this principle though the system has not yet been developed fully for localities encountering extreme conditions. For summer operation the apparatus is supplied with cold water from the evaporator, while the condenser is cooled by water from the cooling tower. When heat is required for the building, the air conditioning equipment is supplied with warm water from the condenser, while the evaporator is provided with warm water from the cooling tower. The changeover is effected by a double-throw switch which controls electrically-operated valves in the piping system. This installation was described briefly at the recent air conditioning conference at Case School of Applied Science.

Data on Operating Cycle of System

Engineers interested in air conditioning machinery might well study this reversed cycle. The following theoretical data, based on a paper which appeared in the February issue of *Refrigerating Engineering,* indicates the possibilities of such a system. In a large ice plant the input of the motor driving the ammonia compressor is about 43 kilowatt hours for each ton of ice produced. The heat equivalent of 43 kilowatt hours is 147,000 B.t.u. Amount of heat which must be removed from one ton of water at 32 degrees to transform it into ice is 288,000 B.t.u., thus by an electrical input equivalent to only 147,000 B.t.u., it is evident that at least 288,000 B.t.u. were extracted from the water at 32 degrees. Therefore, the coefficient of performance of this ice plant as a refrigerator is at least 1.96. Heat given off in the condenser is approximately the sum of the heat absorbed from the ice plus the heat equivalent of the input to the motor. The coefficient of performance of this ice plant used as a heater is, therefore, 2.96, which means that the ice plant delivers almost three times as much heat to the condenser as the heat equivalent of electric input to the motor.

Some of the reasons which have been advanced as to why such a system has not been developed for commercial use indicate that the designer is one of the individuals who must take the first steps. Few suitable refrigerating machines with the necessary characteristics of safety, quietness, lack of vibration, freedom from service, and high efficiency, have been developed in sizes from 5 to 25 horsepower. The foregoing, and the fact that machines of this size have been bulky and lacking in automatic features, recently was brought out in a discussion by several General Electric engineers.

Develops Slow Speed Clock Motor

THE electric clock has created an extensive field for small motors and has inspired engineers to direct their efforts toward the perfection of a unit which will revolve at speeds slower than those of conventional motors. Its possibilities are decidedly apparent when it is considered that some of the present electric clocks are driven by motors running at 60 revolutions per second, and as many as five sets of gears are required to reduce this excessive speed to that

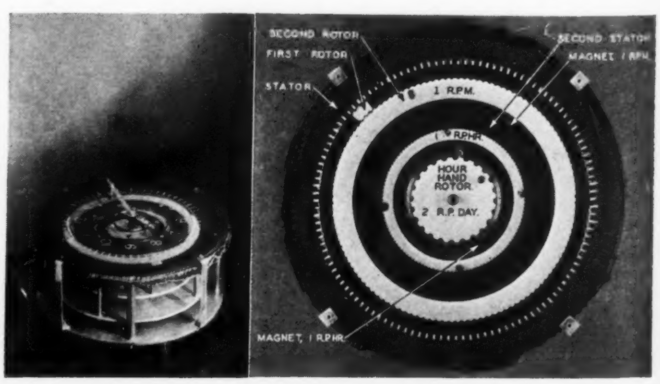


Fig. 1—Clock at left has rotating magnetic field instead of gears. Working parts shown at right

necessary to operate the hands in the proper time cycle. While this power loss is negligible the wear is constant and becomes important in time.

At the Westinghouse laboratories a timing motor that will revolve only twice a day has been developed. Theoretically, there is no limit to the slowness that could be achieved and by following the same principles, speed could be slowed down to one revolution a year or even less. While the idea still is in the experimental stage and the unit is not commercially available, the fact that it is practical and workable has been demonstrated in a clock of unique design, Fig. 1.

One feature of the timepiece is that it has only four moving parts, each of which operates one of the hands. The fastest of these revolves 60 times a minute, another once a minute, the third once an hour, and the fourth operates the hour hand at two revolutions a day. The motor requires no gears for its application as a clock; it constitutes what might be termed an electrical gear in itself. The difference is that its teeth never touch, being held together by magnetism. The entire operation may be explained by saying that each rotor, due to a two-tooth difference between the stators and rotors, travels only two teeth for each revolution of its magnetic field. By changing the number of teeth any desired speed may be obtained.

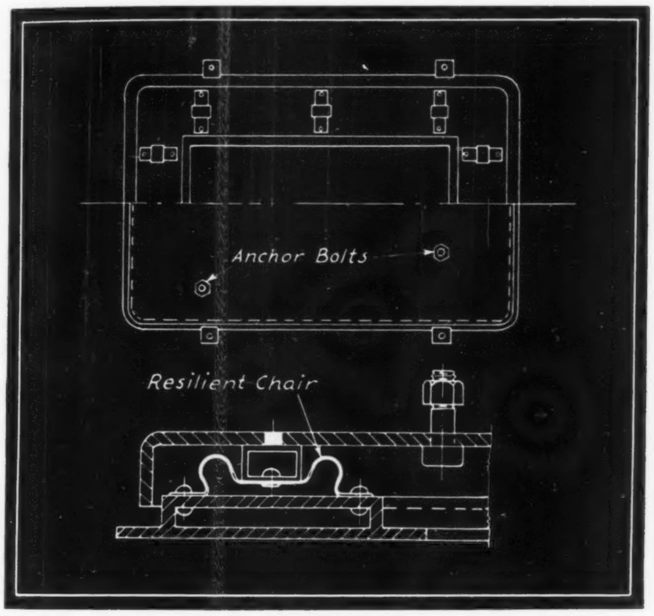


Fig. 2—(Top)—Sound insulative base with section of platform removed. (Bottom)—Section through base

Insulative Base Employs Springs

TO DEADEN noise and vibration of machinery in order that they will not be transferred to building structures, engineers have sought out various ideas for resilient supports, one of which is the arrangement depicted in Fig. 2. This sound insulative machine base has been developed by the United States Gypsum Co., Chicago. It embodies resilient spring construction, being essentially a rigid platform suported on sensitive high carbon steel springs, which form the only direct connection with the floor.

Every machine base is designed individually for the particular piece of equipment it is to carry. The characteristics of the machine such as weight, speed, amplitude and frequency of vibration, center of gravity, torque, etc., are taken into consideration. Supplementing the action of the springs is a dry fill which is both fireproof and sound absorbent. This fill is placed in that section of the base resting on the floor. The suspended frame to which the machine is attached is made of steel with either a concrete or a steel platform.

The springs are cadmium plated or covered by a special coating for resisting corrosion. Snubber springs also are provided for stabilizing the machinery when necessary.

Rolls Drive by Magnetic Force

TYPICAL of the evolution of an idea is the magnetic pulley or roll which first found practical application in the magnetic separation of iron and steel. With a few changes in the outward design of the unit to meet conditions, but employing the same principles of utilizing magnetism, these magnetic pulleys now are being used to carry flat steel sheets and pipe. The magnetic conveyor rolls act as the driving members of the system and because of the affinity of the rolls for the sheets or pipe, created by the magnetic lines of force, this type of unit virtually provides a positive drive. Pipe-carrying conveyor rolls, as introduced by Magnetic Mfg. Co., Milwaukee, are illustrated in Fig. 3 herewith.

Fig. 3—Pipe-carrying conveyor rolls are energized to effect positive driving action magnetically

Construction showing the manner in which the coils are arranged in the rolls is depicted in Fig. 4. Energization of the coils magnetizes the shell of the roll. Electric current is supplied to

these coils by wires from the collector rings. The lead wires are brought out of the coil pockets, recessed in the supporting heads, and extended through a hole in the shaft to the collector rings. The manner in which the ends of the rolls are fastened to the cylindrical shell also is shown.

The largest installation of magnetic equipment for the handling and conveying of steel sheets and pipe magnetically now is installed at Republic Steel Co., Youngstown, O.

Crushing by Eccentric Motion

EMPLOYING eccentricity to obtain compression, engineers have accomplished striking results. A gyrocentric crusher has been produced which embodies a somewhat similar principle to that used in a number of blowers and refrigerating units. The machine, built by the Patterson Foundry & Machine Co., East Liverpool, O., has only one moving part, a manganese roll, as shown in Fig. 5. The roll, by rapid gyrocentric motion, operates against concave crushing plates. Two are used, one at each side, to increase the productivity of the unit.

Another feature of the machine is the fact that the entire crushing chamber is utilized since crushing action takes place almost immediately upon feeding the material into the hopper. The roll has a steel shell which does not revolve with the shaft but creeps slowly so that wear is distributed evenly over its entire circumference.

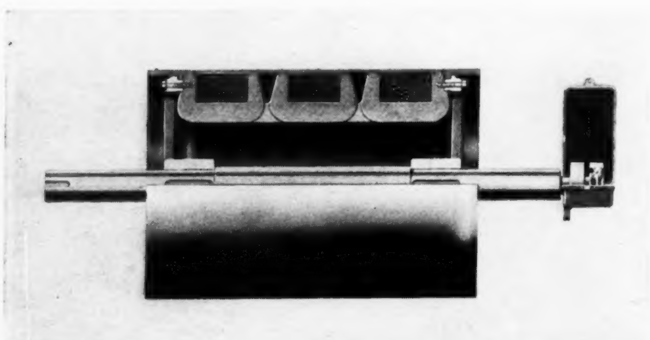


Fig. 4—Cutaway view to show construction of coils in the interior of a magnetic conveyor roll

The revolving eccentric shaft imparts the gyrocentric motion to the roll.

The crusher plates are reversible to compensate for wear, and safety breaker plates are provided to guard against damage when tramp iron or other foreign material lodge in the crushing chamber.

Gunpowder Now Serves Industry

GUNPOWDER, long confined to projecting destructive missiles, now is finding a new role in which it becomes constructive. Employed in an industrial gun perfected by Robert Temple, noted wartime inventor, the explosive properties of gunpowder promise to aid engineers seeking a new source of power. Already it has proved successful in driving rivets, splicing electric cables, and repairing the hulls of ships under water.

Unlike the reaction that takes place in the firing chamber of a firearm, with which there is a certain amount of recoil, the Temple velocity gun develops the maximum amount of power in a given charge of powder before any action takes place. Movement of the parts is restrained by

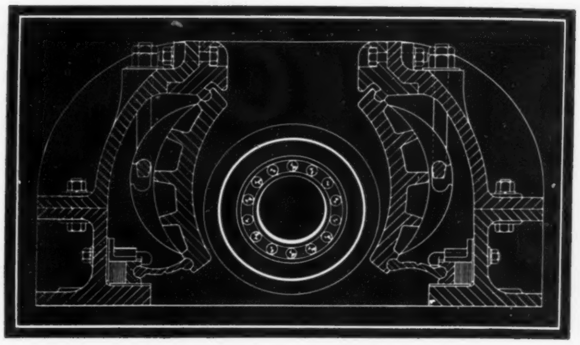


Fig. 5—Crusher depicting roll which operates against concave plates by rapid gyrocentric motion

a shear pin or a threaded member until the powder is entirely burned. Because the projectile, piston, ram, bolt or rivet is not allowed to move until all the energy in the powder has developed, and the explosion confined to the sealed chamber, recoil is eliminated.

At the present time Temple Velocity Equipment Inc., New York, is confining its efforts to developing light portable equipment for field use. The cable splicer, Fig. 6, is an example of this class of tool. A small, special blank cartridge, exerting its energy upon a piston which in turn impacts on a die, instantly compresses a connector sleeve containing an insert of cable wire, the two pieces of which enter the gun from opposite sides. After the discharge, unnoticeable except for a slight click, the cable is removed as a single piece swaged together at the joint.

The power of this device is best illustrated by the actual performance of the driver used for ½-inch studs. This unit weighs 15 pounds and is 18 inches long. It will drive either a solid pin, hollow stud, threaded or tapered stud, through steel 1⅜ inches thick, without utilizing previously drilled holes. United States navy tests have proved that the frictional hold of a ½-inch stud in a ½-inch steel plate is such that it requires 14,000 to 16,000 pounds of hydraulic pressure to remove the stud from the plate.

With rocket cars utilizing powder, and now this development of a powder-powered device for industrial applications, it would seem that a field is opened for still further progress in the use of

this form of energy. The idea is revolutionary and holds tremendous possibilities for engineers to consider.

Floating Principle Used in Drive

MASS production has made unusual demands on engineers developing materials handling equipment. Employment of longer and more heavily loaded conveyors has necessitated the use of multiple drives on a single strand of conveyor chain to keep down the weight and cost of chain and carrier units. One of the innovations to meet this requirement comprises a floating type of driving mechanism so arranged that two or more drives located at a considerable distance from each other will synchronize automatically and thus maintain proper driving action at each drive point.

The design of this unique drive was described by N. H. Preble, chief engineer, Jervis B. Webb Co., Detroit, Mich., at the last annual meeting of the materials handling division of the American Society of Mechanical Engineers. To provide a simple and fully automatic synchronizing medium, the floating drive was developed and has been applied successfully to overhead and other forms of conveyors. In this type of drive the moving frame and machinery units including a variable speed transmission, are mounted in a separate and fixed frame, being carried and also guided within this frame by means of rollers, as shown in Fig. 7.

Reaction of the drive effort on the conveyor chain will move the frame parallel to the conveyor, this movement being counteracted by a pair of coil springs attached to the fixed frame and bearing against the floating frame. The strength of these springs is adjusted properly to counterbalance the calculated chain tension at each individual drive point. If the chain tension or driving effort goes above the calculated figure, the coil springs will be compressed beyond their normal position and conversely, if the reaction is less than normal the floating portion of the drive will be moved in the opposite direction by the springs. This tendency to movement is the operating medium of the speed control. The adjusting shaft of the variable speed mechanism is connected to the fixed frame through a series of gears and levers, so that if the drive moves back under excessive load it will be slowed down automatically, and vice versa.

Because this same principle can be applied to other types of conveyor drives, it offers designers of this class of machinery a basic idea that may prove helpful in solving their problems.

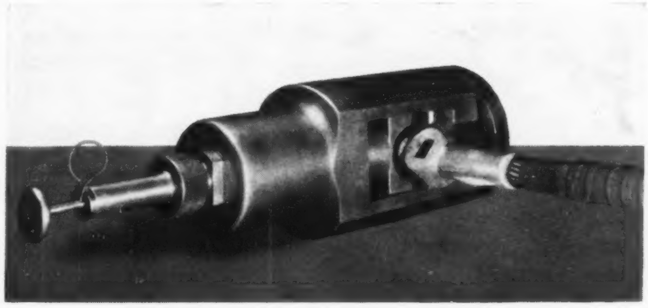


Fig. 6 — (Above) — Gunpowder is used in this cable splicer to actuate a piston which impacts on a die to swage wires into a continuous piece

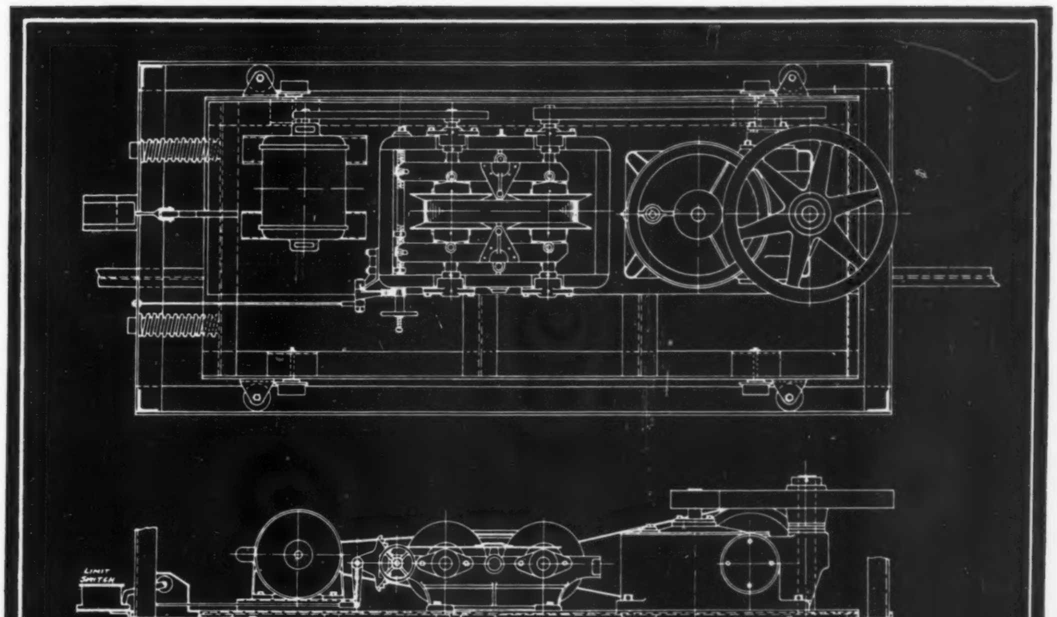
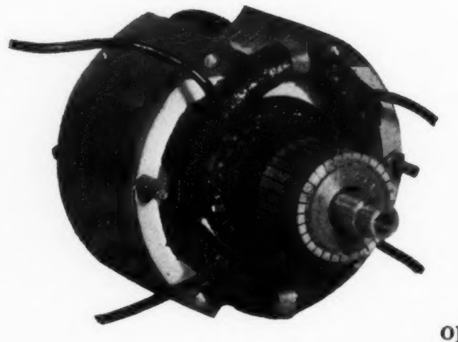


Fig. 7 — Arrangement of conveyor mechanism employing floating principle to synchronize automatically two or more drives located at considerable distances from each other. Top and side views of the drive are shown in the illustration at right

Universal Motors Demonstrate Fluctuating



By E. L. Connell

UNIVERSAL motors are descendants of the direct current series motor and retain the essential characteristics of such motors. The rotating member is the familiar wire wound armature with commutator and brushes. The stationary member, or field, has a low resistance winding connected with the armature to give a single continuous path for the current; in other words a series field winding.

Those familiar with motor performance realize that the series motor has no fixed operating speed. The speed varies with the torque or resistance to rotation imposed by the load. No-load speed will be 50 to 100 per cent higher than the speed under load.

A motor of good design, one that is universal in the best sense of the word, will show approximately the same speed torque characteristics from no load to full load regardless of the kind of current supplied. There is, however, a tendency to show a higher speed under heavy loads when operating on direct current. The difference in direct and alternating current speed at heavy torque will be greater at 60 than at 25 cycles.

The universal motor is a high speed motor and delivers more power per pound of weight than any other motor which can be operated from the common sources of current. Induction motors operate at a speed determined by the frequency of the supply and the number of poles produced by their winding. The maximum speed possible is 60 times the frequency in cycles per second; 3600 revolutions per minute from a 60 cycle circuit. A universal motor may operate at twice this speed under load.

The ability of these motors to start the heaviest loads efficiently is an outstanding advantage. Acceleration is smooth without the critical "pull-in" point and current inrushes typical of single phase induction motors.

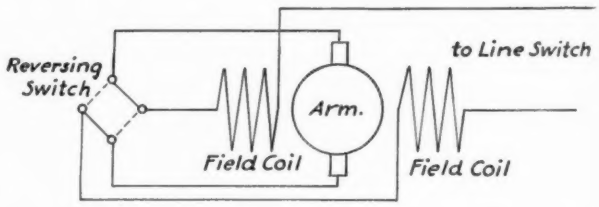


Fig. 3—Reversing connections for salient pole motor

Since the universal motor drops in speed with an increase in torque, it shows exceptional flexibility and stamnia on loads that fluctuate suddenly and widely. Peak loads that would cause an induction motor to drop back upon its starting winding with almost certain destruction are met with a drop in speed commensurate with the increase in torque required.

It will be apparent that since this motor op-

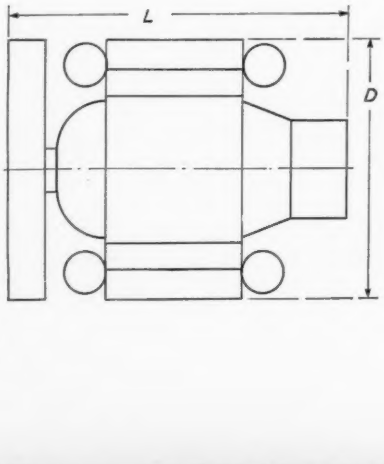


TABLE I

Salient Pole Motors

Standard D *	Approx. Max. L	No Load R.P.M.	Normal Full Load Rating			Weight Field Armature and Fan
			Output Watts	Approx. H.P.	R.P.M.	
2.875	3.875	15000	95	1/8	9000	2 1/4 Lbs.
3.1875	4.25	14500	170	1/4	8800	3 1/4 Lbs.
3.6875	5.0	14000	300	3/8	8500	5 Lbs.

* Established by N.E.M.A.

Remarkable Adaptability for Load Service

Fig. 1—(Extreme Left)—Most familiar type of universal motor, the salient-pole type. Fig. 2—(Adjacent)—Compensated type of universal motor

erates like a series direct current motor its speed is subject to control by voltage regulation. Such a procedure is entirely practical when the load is constant or when the controller can be regulated to compensate for load fluctuations.

It is not wise to put an arbitrary limit on the size of these motors, but the fact that they usually are operated from a lighting circuit confines them more or less to the fractional horsepower class. They are built in varying quantities from

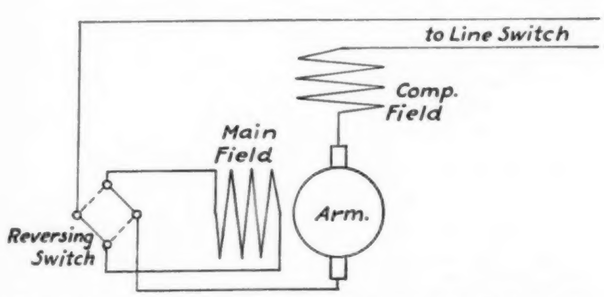


Fig. 4—Reversing connections for compensated motor

a few watts to a thousand watts maximum.

There are numerous applications where the negative qualities may nullify the positive advantages. The high speed is accompanied by more or less noise, and commutator and brushes must receive the attentions demanded by all commutating machines. Reduction gearing often is necessary to bring the speed down to a usable range, and the cost of the combination may eliminate it where weight and speed torque characteristics are not the deciding factors.

Summing up the possibilities of the universal motor, it is especially applicable:

1. For portable devices which must be operated from any lighting circuit
2. For high speed; greater than possible with induction motors
3. For portable devices where minimum weight is imperative
4. For devices requiring great starting torque
5. For devices imposing a violently fluctuating load upon the motor
6. For a variety of load requiring speed control

Great impetus was given the art of designing and building universal motors by the portable tool industry. The rather small power requirements of the small household devices did not call for the construction of a motor of performance and stamina suitable for the abuse of portable electric tool service. A study of portable tool applications will, therefore, reveal much about the possibilities of universal motors.

The most familiar motor is the common sal-

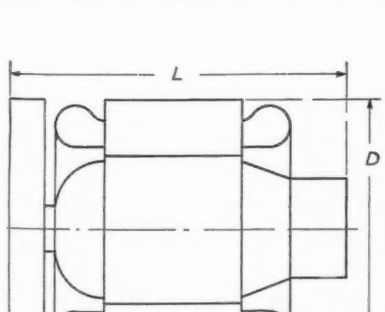


TABLE II

Compensated Motors

Standard D*	Approx. Max L	No Load R.P.M.	Normal Full Load Rating Output Watts	Approx. H.P.	R.P.M.	Weight Field Armature and Fan
4.125	5.81	13000	500	2/3	7000	8 1/2 Lbs.
4.375	5.625	13000	500	2/3	7000	8 1/2 Lbs.
4.375	6.375	13000	650	7/8	7000	10 3/4 Lbs.

* Established by N.E.M.A.

ient-pole type found in vacuum cleaners, Fig. 1. It has been found practical to use this construction for motors with a maximum output as high as ⅝ horsepower. Conservative practice is about in line with the figures given in Table I.

Motors of smaller diameter are available but no standard has been adopted. It should be understood that all the figures given in the table, except the diameters, are not for accurate layout work but serve as general information.

Performance characteristics of the motors in this group are averaged in the curves of Fig. 5. The smaller ratings will show a maximum efficiency below 55 per cent and the larger ratings as high as 60 per cent. The power factor, in contrast with induction motors, is practically 100 per cent at no load. Normal load is the load corresponding to the usual temperature limitations for electric motors.

Skillful Design Required

Motors of capacity greater than the maximum of this group are compensated to get the desired characteristics. This type requires skillful design but can be made to perform much better than the salient-pole type. They are distinguished easily by the fact that the field winding is distributed in slots completely surrounding the armature, Fig. 2.

There are two sizes of compensated motors in general use, 4⅛ and 4⅜ outside diameter. These are, unfortunately, rather badly related as Table II will indicate. They are too close together and overlap considerably in capacity. At maximum length the smaller diameter is good for almost as much as the larger but it is suggested the larger be used unless the ¼-inch smaller diameter is a decided advantage. Capacities greater than those listed can be built.

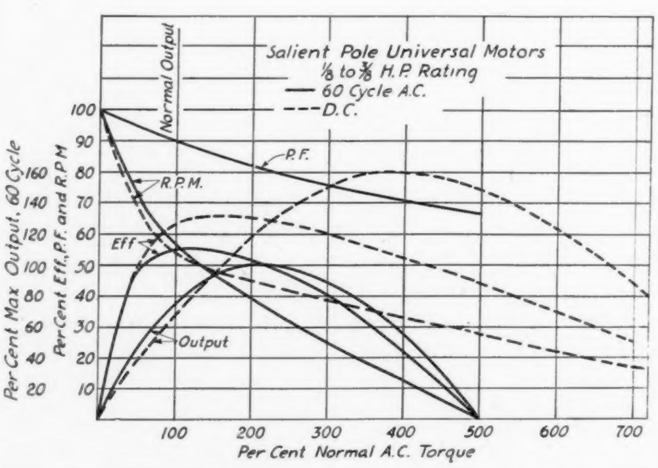


Fig. 5—Performance characteristics of salient pole motors

When extreme saving in weight is not especially desired and the other advantages of the universal motor are more important the speeds indicated can be reduced by designing with more than two poles.

In applications requiring maximum output for a given weight, there is temptation to overdo. The maximum outputs for the sizes shown in Tables I and II can be exceeded but it usually is found that destructive heating appears. Torque produced at stall per ampere drawn from the line is a good measure of the capacity of the motor to absorb severe overloads without destruction. On 110 volts 60 cycles these motors will deliver from 1 to 2 ounces feet of torque per ampere. The best salient pole motors will show about 1¼ and the best compensated motors at least 1½ ounces feet per ampere of stall current.

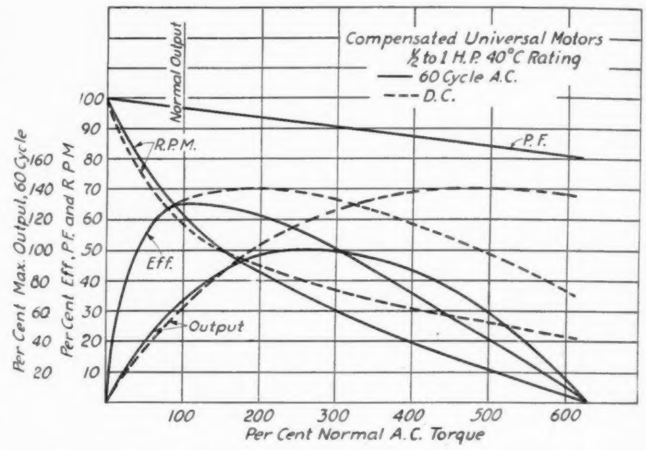


Fig. 6—Typical characteristics of compensated motors

Universal motors can be built for reversing service. In the salient pole type the reversing switch is connected to interchange the brush holder leads as shown in diagram Fig. 3. There are two methods of obtaining compensation in the larger motors. One makes use of a single winding with the brushes considerably off the neutral position. Such a motor is not reversible. The motor which gets its compensation from a double winding will operate equally well in both directions. When this type has four leads, two from the main field winding and two from the compensating winding, the motor is reversed by interchanging main winding leads, Fig. 4.

One of the common errors of designers who do not have the motor manufacturer's experience is in the matter of clearances allowed for coil ends and live parts. The motor winder considers it a hardship to hold his coil ends within a tolerance closer than plus or minus 1/16 inch. The clearance between live parts and the housing of the motor should not be less than ¼ inch. With the larger motors the winding is distributed around the stator and sufficient clearance should be allowed between coil ends and housing for free passage of ventilating air. Also this type should be provided with an air passage between the iron coil of the motor and the housing.

Alloy Steel Solves Bearing Mounting Problem

By D. L. Holbrook

ADOPTION on a large scale of the controllable pitch propeller is an important step which it is freely predicted the aircraft industry will make within the next few years. The advantages to be gained by the use of such a device are somewhat akin to those of a selective gear transmission in an automobile. The controllable pitch propeller will allow a take-off either in a shorter distance or with a greater load without sacrifice of high speed characteristics. This is by virtue of the fact that the full engine power can be utilized in take-off together with greater propeller efficiency in the low pitch position. Rate of climb will be affected favorably. The greater the range between landing speed and high speed the more advantages this type of propeller brings into play.

Tests made on the hydro-controllable airplane propeller have proved successful. The design has been proved from both operating and manufacturing viewpoints and the widespread use of the device now should be not far in the future. Doubtless its first general use will be in military or naval aircraft where the maximum performance is of paramount importance. The desirability from a commercial airlines standpoint, will be based on the increased economies which can be gained through its use. An installation of the controllable pitch propeller made by Hamilton Standard Propeller company is shown in Fig. 1.

For the low pitch, or take-off, blade setting, oil from the pressure system of the engine is admitted through a three-way valve into a hollow section in the forward end of the propeller shaft, Fig. 2. On the end of the propeller shaft is mounted a fixed piston. An orifice in the head of the fixed piston permits the oil to flow into a cylinder chamber, the cylinder itself being the moving member and actuating the blade pitch-changing mechanism.

When sufficient altitude is gained after take-off it becomes desirable to increase the blade pitch angle and throttle the engine to cruising revolutions per minute. This is accomplished by shifting the three-way valve so that the oil in the cylinder chamber can drain into the crankcase. To assure a positive return to the high pitch setting, counterweight arms, moved by centrifugal force, are linked to the movable cylinder. The angle of pitch in either the maximum or minimum pitch settings can be adjusted

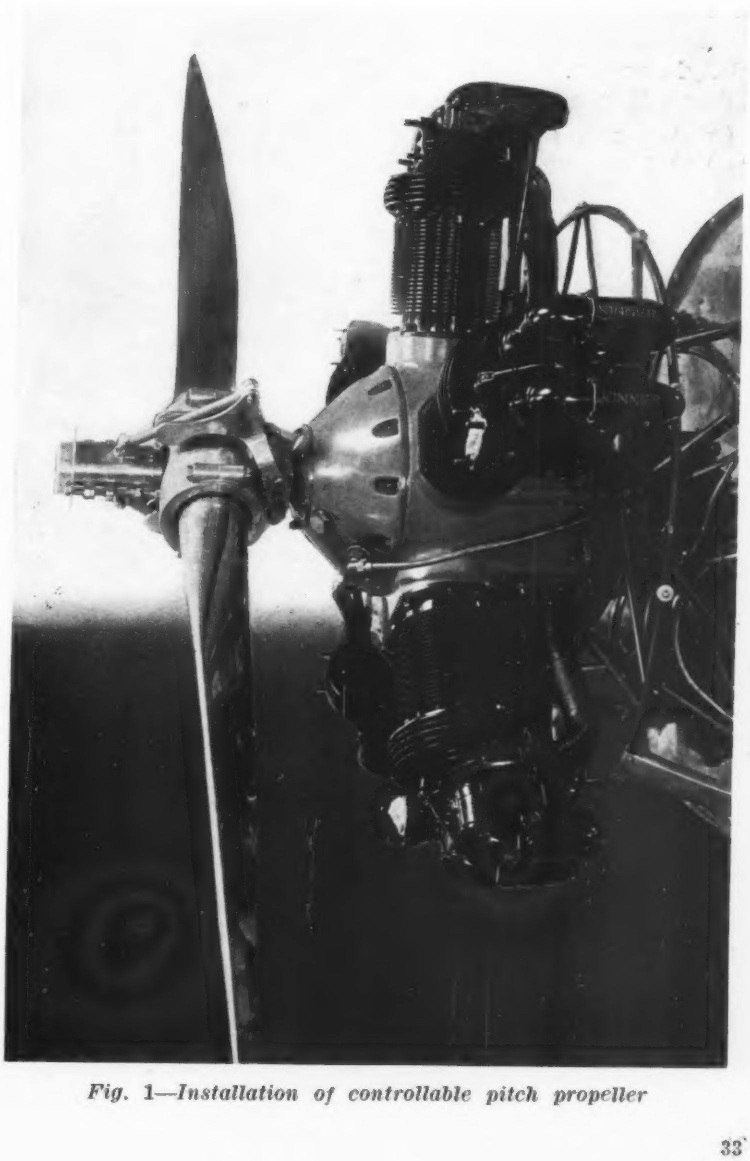


Fig. 1—Installation of controllable pitch propeller

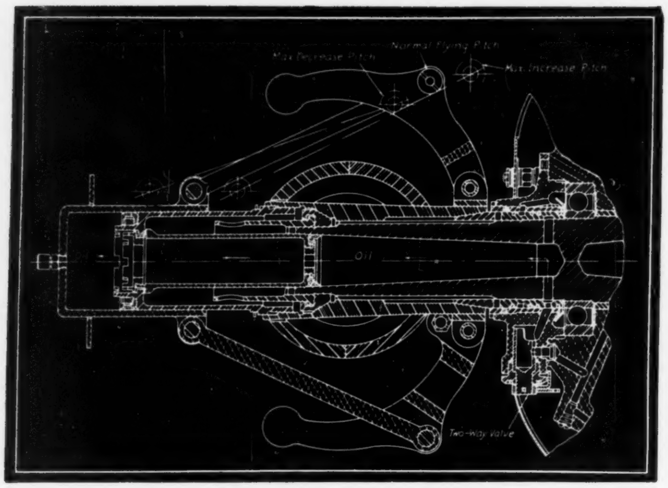


Fig. 2—Mechanism for adjusting pitch of propeller for take-off

on the ground, by changing the position of the stops limiting cylinder travel. The valve is operated manually by the pilot through a flexible push-pull cable running into the cock-pit.

With such an arrangement, oil pressure in the cylinder need be maintained only during take-off and climb, which, in commercial airplane operation, constitutes a small percentage of total flying time. Reduction of the danger of oil leakage in the system is thus effected.

One of the interesting problems which has been met and solved in the development of this propeller is the method of mounting the antifriction thrust bearings which carry the centrifugal force exerted by the blades. Due to space limitations, the general dimensional proportions of the bearings and the loads encountered, a roller thrust bearing has been chosen using a large number of small diameter rollers.

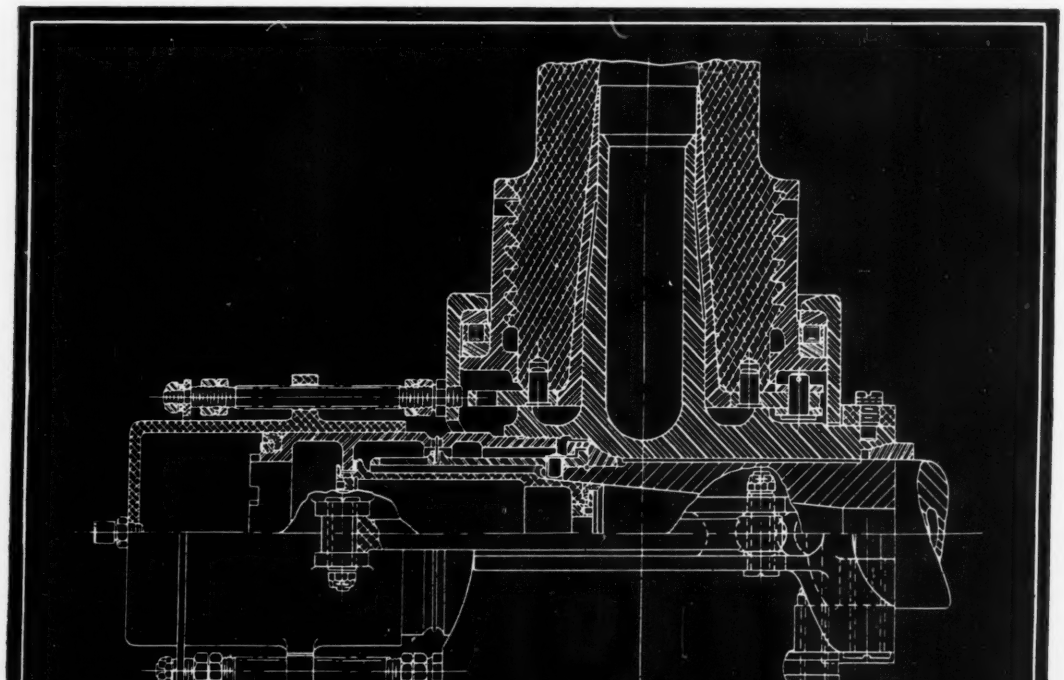
Bearing Load Comparatively High

Angular travel amount is small, being approximately 10 degrees between the maximum and minimum pitch settings. In the case of a propeller suitable for use with an engine of 450 horsepower, the maximum thrust load to be taken by the antifriction bearing is 80,000 pounds. For the size of bearing employed this load is comparatively high, but since only one change of pitch is needed during any one flight static conditions prevail.

The first experimental thrust bearings were of the split type, Fig. 4. Although this construction is extremely expensive where accuracy must be maintained, it nevertheless allowed this bearing to be mounted on the finished blade, abutting a flange on the root of the blade integral with the blade itself. This type of bearing gave quite satisfactory results on test, but was discarded due to its cost.

The next stage of development made use of a one-piece washer type of thrust bearing slipped over the root of the blade and secured there-

Fig. 3—Second stage of development of bearings for propeller made use of a one-piece washer type. Machining required to secure this bearing to the blade transgressed the bounds of good design practice, besides being a costly method



to by means of a steel ferrule, Fig. 3. The machining required to affix the ferrule to the blade, besides being a costly method, transgressed the bounds of good practice in propeller design since it necessitated the use of a threaded section on the root of the blade which, of course, would be extremely undesirable from a fatigue standpoint.

The design of the bearing mounting which, in co-operation with the Fafnir Bearing company, finally was decided upon, and which is to be considered standard in the future, embodies a rather radical departure from the usual antifriction bearing mounting practice. Eliminating the undesirable features from the first two bearing mounting designs, it aptly illustrates how the choice of material can go far in solving design problems.

In this design a high carbon steel containing about 8 per cent chromium and 8 per cent tungsten, developed originally for high quality cut-

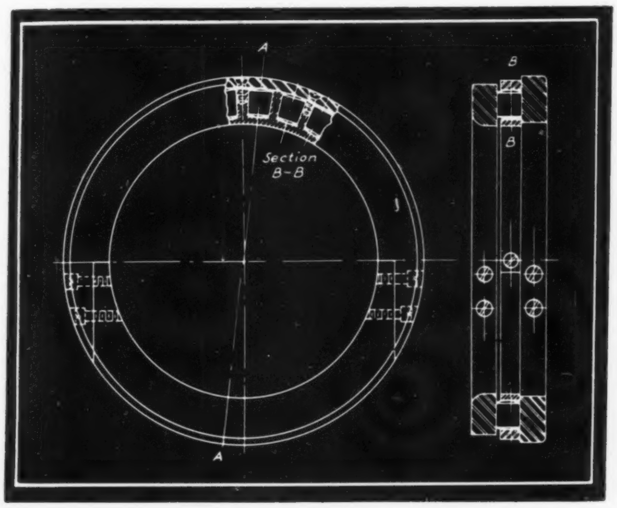


Fig. 4—The first experimental thrust bearings were of the split type

lery and surgical instruments, was substituted for the high carbon chrome steel customarily used in antifriction bearings. As might be judged from the quantities of alloying elements, the characteristics of the steel represent a combination between a high speed and a stainless steel. Quenched in oil from 2100 degrees Fahr. this steel has a primary hardness of approximately 60 Rockwell C, and the subsequent draw at 1000 degrees Fahr. for 2 hours produces a secondary hardness of 61 to 62 Rockwell C. Like a high speed steel, no subsequent heat treatments at temperatures lower than that at which it was drawn have any material effect upon the hardness. The presence of the chromium prevents all but microscopic oxidation on the surfaces of rolls or races.

Consequently a bearing which would withstand temperatures not exceeding 1000 degrees Fahr. became available. The mounting practice

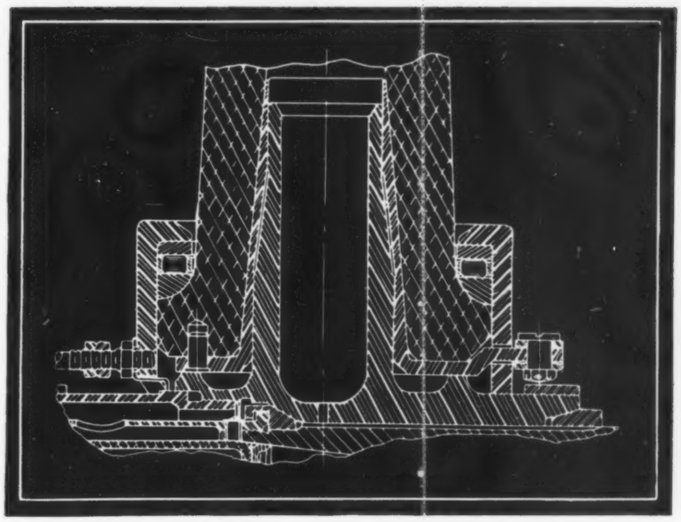


Fig. 5—Final design of bearing is a radical departure from usual antifriction bearing mounting practice

now employed is to slip the entire bearing, consisting of two flat washers between which is the roll assembly, over the root of the blade and as far up the blade as possible. This method then allows the end of the duralumin blade to be heated to a forging temperature of 950 degrees Fahr. at which a flange is created by upsetting in a forging machine. Heat treatment of the entire blade must be performed by heating to 950 degrees and quenching in water. The forging and heat treating temperatures do not cause distortion of the bearing rings nor reduce their hardness.

No Interference to Machining

Since the size of the propeller blade is such that the bearings can be moved six or eight inches away from the face of the flange, the machining of the flange and the fillet may be accomplished without interference. Fig. 5 shows the assembly of the bearing in the hub. From the tests performed on assemblies of the first and second designs it was found that the use of a small fillet radius on the root of the blade adjacent to the inside bearing washer gave trouble because of a tendency to crack directly under the inside washer. Larger fillet radii were tried and proved to be the corrective measure required. The final design, Fig. 5 shows how the section of the inside washer has been modified to a shape that is approximately a segment of a circle. Stress distribution was greatly improved in the root of the blade by this method of mounting the bearing.

Although bearings made of this steel would, of necessity, cost more due to the increase in cost of material, it is quite possible that many applications will be brought to light in the future where this principle of mounting can be employed to effect a net saving in the total cost of an assembly.

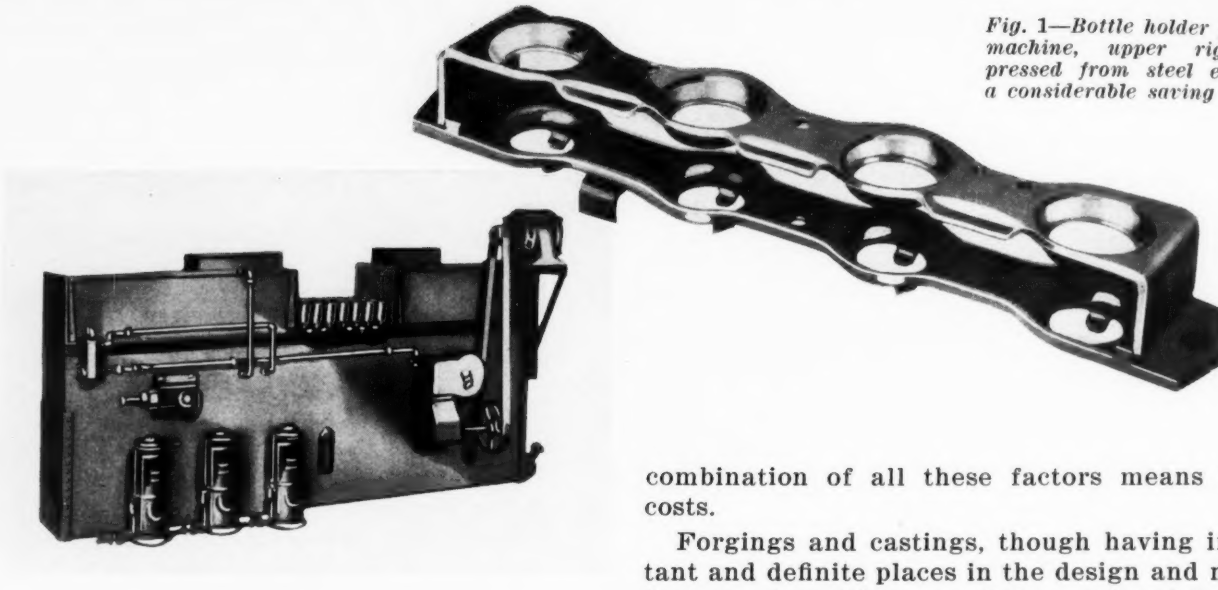


Fig. 1—Bottle holder for this machine, upper right, is pressed from steel effecting a considerable saving in cost

Cutting Costs with Pressed Steel

By Chester B. Gleason

SELECTION of sheet or strip steel for pressing depends entirely upon the product to be made, sheet steel being wider and usually thinner than strip. Both will draw in dies, both may originate in the same open-hearth furnace heat and therefore be of identical likeness in their chemical content. The cost of one may be greater per pound than the other, but economies can be effected by using the higher priced metal due to, say, multiple punching or blanking or some similar factor.

The field for pressed steel is indicated clearly in any part, article or machine produced in quantities, particularly when portable or mobile. Stampings combine strength with lightness and are alike and uniform in accuracy. Unless the part is of a particularly intricate design, minute and individual inspection is not necessary. The combination of all these factors means lower costs.

Forgings and castings, though having important and definite places in the design and manufacture of machines, are being replaced in some instances by stamped steel parts. Strip steel, in one case, has supplanted a more costly forging in being blanked, punched and formed into chain sprockets, as for motorcycles, Fig. 2. Of proper analysis, it takes hardening and is easily plated and polished for appearance. In a milk bottle washing machine the bottle holder, formerly a casting, was redesigned for pressing from steel with a consequent slash in cost. Harder, it is used in agricultural reaper blade sections and similar parts. It may be blanked and pressed for brake drums, fan spiders, hub flanges, frames, legs and supports. It is welded readily, and several pressed parts can be assembled by welding as in gasoline dispensing pumps, Fig. 4, or washing machines.

Electrically welded tubing, because of uniformity, may be used for propeller tubes, Fig. 6. This tubing—all made of strip steel—is used as cylinders for grease guns and drip tubes, as well as in oil and gas pumps; in printing presses and refrigerator cooling coils. A new and novel use is electric heating elements, the welded tubing containing the element proper and the insulator.

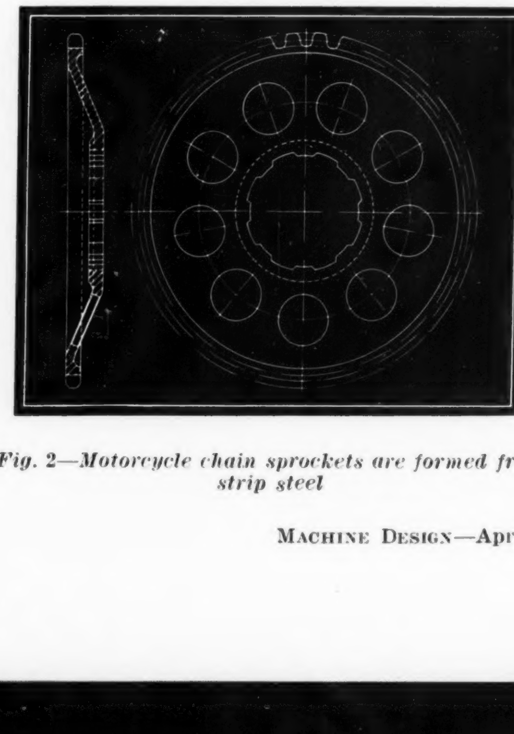


Fig. 2—Motorcycle chain sprockets are formed from strip steel

The tubing also is employed for machine frames, as in various textile machines, etc.

Flat rolled steel of heavier gages is strengthened by welding for heavier machine bases, frames, etc. Pressed sheet steel for oil pans, dust covers, guards, switch boxes and so on almost without end is an every day occurance, yet there still are wide fields of application. In fact, basic open-hearth steel, because of its ductility, whether it is rolled into strips or sheets, lends itself to stamping or forming into numerous parts and articles where these are not subjected to excessive constant friction, in which event bearing metals are indicated at contact points, as in an idler or tension pulley or sprocket.

Elements Have Specific Duties

As generally known all basic open-hearth steel, strip or sheet, contains four prime elements: Carbon, manganese, phosphorus and sulphur, although other elements often are added to the metal in its liquid state to vary its properties. For instance, copper to retard corrosion; vanadium to overcome fatigue; nickel for toughening and stiffening; chromium for intense hardness; etc. Even the varying of the one element will produce a different result and a combination of elements develop a still different property, as in the case of the now well known KA2 stainless steel.

Fig. 3—Corrosion-resisting strip formed on a press and welded makes an attractive fruit juice dispenser

Carbon is the dominating element of basic steel. Control of this element, like others, is effected in the open-hearth furnace while the metal is molten. From a start of, say, scrap and pig iron analyzing up to 4 per cent carbon, steel is tapped with carbon as low as .08 per cent to .12 per cent. Because of the volume of metal and the fact that tapping and pouring cannot be delayed, until an actual laboratory test is run, sledge tests are resorted to and reliance is placed on the practiced eye of the open-hearth man. It is uncanny to note that the accuracy of his eye is within a few hundredths of one per cent of actual analysis. Sledge tests, of which several often are taken as the bath nears tapping, are simply small amounts of steel dipped out of the furnace, cast in a mold, cooled and then broken with a sledge hammer, the silvery fracture telling its own story. But this is only four or five pounds and carbon frequently has a tendency to segregate. For this reason steel producers ask for their "spread," and as the carbon content increases the spread becomes greater. Typical examples of carbon specifications are; .08 to .12 per cent; .10 to .15 per cent; .20 to .30 per cent; .45 to .60 per cent. etc.

Fig. 4—Blanked and pressed parts are assembled readily in the fabrication of gasoline pumps

Merriman's formula is used extensively for the determination of theoretical tensile strength and it is found to be remarkably close to actual test results. It follows, for basic steel:

$$\text{Tensile Strength} = 38{,}000 \text{ pounds} + 650 \times C + 1000 \times P + 90 \times Mn + 4 \times C \times Mn$$

Note: Values of C, P and Mn are in hundredths of a per cent.

Using this formula, basic open hearth steel analyzing .13C, .41 Mn, .037P will have a tensile strength of 56,772 pounds. Sulphur has little or no effect on the strength of steel, hence it does not enter into the calculations.

In addition to the above formula, it might be well to show also an easily remembered way of

estimating the theoretical weight of strip or sheet steel:

Pieces × width in inches × decimal of gage × length in inches × 5 ÷ 18 plus 2 per cent

Of course, it is easier to refer to weight books for the lineal foot or inch weight, but the books may not always be available.

Many Qualities Available

Sheet and strip steel is made in many qualities and finishes, all of which have their particular uses. A few are blue annealed and black sheets, enameling, double seaming, deep and extra deep drawing, auto body and furniture stock. In strip the varieties are about as broad. Hot rolled strip steel may be made for deep and extra deep drawing, as discussed in this article, for hoops, ties, bands, cutlery blades, for hardening and so on. Cold rolled strip steel is a separate product and is made as the name implies, that is, by passing hot rolled strip steel one or more times through cold rolls. It is invariably of low carbon content but is supplied in several degrees of hardness produced by the rolling process because steel, like some other metals, hardens upon being cold worked. Annealing this strip in specially constructed and handled furnaces makes the metal soft without injuring its smooth finish which in some instances is almost mirror-like. It is remarkably close to gage and therefore adaptable for stamping and drawing.

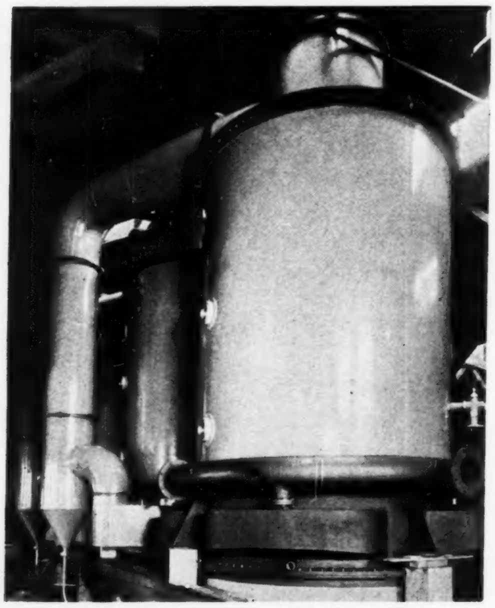


Fig. 5—Alloy sheets pressed and welded aid in producing a pineapple cooker at low cost

Economies may be effected by using cold rolled strip in combination with hot rolled as, for instance, in clutch plates or disks. Cold rolled makes up the smooth plate and this friction plate is riveted to hot rolled. Products of cold rolled may be painted, enameled, plated or otherwise finished for appearance with little preliminary work. They may be used wherever hot rolled strip of like analysis is used and because of the well finished and superior surface cold rolled is blanked and formed for the finer machine parts, as typewriter, cash register and adding machine details. This steel has been rolled to paper-thinness and now is used for shim stock; it is too early as yet to say how else it may be employed because of its comparatively recent development.

All steel makers—of sheets and strips as well as any other form—maintain departments, under whatever name, whose business it is to know not only the manufacture and rolling of steel, but also the effect of various combinations of elements on the steel and in the finished product as well as in its use. Engineers or companies interested in the shaping and use of steel, will find the steel producer anxious and willing to cooperate.

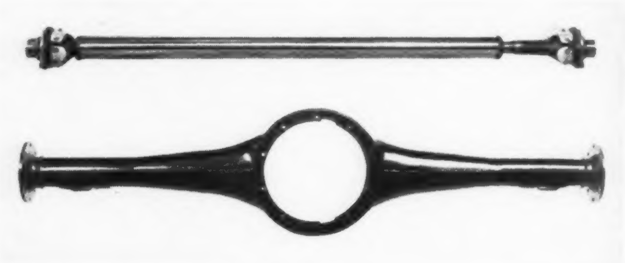


Fig. 6—Electrically welded tubing made of strip steel may be used for propellor tubes (top). Pressed steel, welded into an assembly, gives a low-cost rear axle housing

The considerate co-operation of the following companies who assisted in supplying illustrations for this article is acknowledged: Associated Alloy Steel Co., Cleveland; Harley Davidson Motor Co., Milwaukee; A. O. Smith Corp., Milwaukee; Steel & Tubes Inc., Cleveland; and Youngstown Pressed Steel Co., Warren, O.

Introduces Symbols for 69 Quantities

SYMBOLS for mechanics, structural engineering and testing materials have been approved by the American Standards association as American standard. The standard consists of letter symbols for 69 quantities commonly used in these fields.

These symbols were prepared by subcommittee 1 on mechanics, structural engineering and testing materials of the sectional committee on Scientific and Engineering Symbols and Abbreviations. The sectional committee is under the sponsorship of the American Association for the Advancement of Science, American Institute of Electrical Engineers, American Society of Civil Engineers, American Society of Mechanical Engineers and others.

Simplicity, Light Weight Are Aims in Domestic Machinery

By Allen F. Clark

Editorial Representative, Machine Design

HOUSEHOLD appliances which must be moved easily from place to place constitute one type of machine in which weight reduction is of extreme importance. This equipment also must be so built that frequent attention to mechanical parts is not necessary. At the times when some repairs are required, the design must be such that a neighborhood repair man, not necessarily trained to do the work, can clear up the difficulty without the necessity of returning the machine to the factory. Another attribute is extreme smoothness of operation. When all these requirements can be met, and at the same time costs can be reduced, a high point in design is reached.

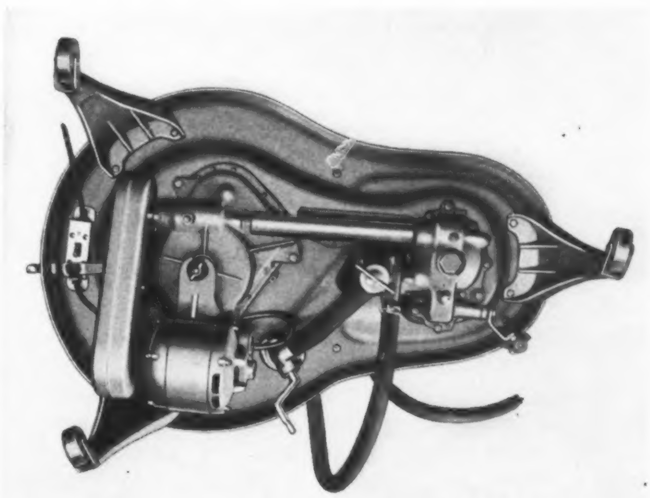
Such results have been accomplished in the design of a washing machine by Apex Electrical Mfg. Co. who in 14 years development and research has reduced the number of parts in its machine from about 700 to less than 100, exclusive of the nuts and bolts, and reduced weight considerably by the extensive use of zinc and aluminum die castings and pressed steel parts. The top frame of the washer, shown in Fig. 1, is unique, inasmuch as it is one of the largest single die castings attempted in any metal. It is zinc die-casting metal and is highly finished within the polished head. The flanged construction of the frame provides additional stiffening or bracing for both compartments of the tub structure.

Stampings are combined with gray iron castings in the drier gearcase and the washer gearcase. In the gearcase and cover alone, this combination resulted in a reduction in weight from 35 to 10½ pounds.

Another die casting is employed in the double dasher, or agitator, Fig. 5, which is the solution of an unusual design problem. It was necessary to provide a rapid undercurrent wave motion of strong suction and repulsion propensities, fasten the propelling means securely to the shaft, balance the entire mass in order to eliminate vibration, and leave no projecting edges or open crevices which might catch delicate fabrics.

These objects were reached only after considerable research in the action of water in de-

Fig. 1—(Below)—Improved design of wringerless washer. Fig. 2—(Bottom)—Compact arrangement of operating mechanism for agitator and drier



termining the shape of the agitator. It is mounted on a hexagonal tapered head which holds it firmly without rocking, while a retainer screw further abates the tendency toward vibration. There is just sufficient clearance to prevent rubbing on the conical bottom of the tub.

The agitator is driven and reversed through a segment and pinion movement, Fig. 3, while speed reduction is made through a belt, worm and worm gear. This worm gear, *a* has pinned to it an eccentric, *b*, on which is fitted the pitman, *c*. The pitman is pinned to a circular rack, *d*, at *e*, and this rack through engagement with pinion, *f*, oscillates the agitator head. The worm gear and the eccentric rotate in one direction on bushings inside of which the agitator shaft oscillates. Lubrication for this shaft is brought about by spiral grooves in the shaft which draw oil up from the gearcase.

To obviate the necessity of bringing the circular rack into contact with the driven pinion from the side, thus creating difficulty in meshing the gears, a mechanism has been created which draws the rack directly back from the pinion when disengaging, and thrusts it into engagement along a straight line. This straight line motion of engagement reduces to a minimum the shock of contact as it immediately permits full engagement of the teeth.

Shifting of the rack is accomplished through a shifting sector, Fig. 4, keyed to the center post *g*, Fig. 3. This post has three teeth which engage similar teeth in the segment *h*. Rotation of this center post will draw the segment toward or away from the agitator post and thus bring the rack and pinion into or out of engagement. The circular rack travels on the segment through a tongue and groove fit at *k* which is lubricated in an exceedingly ingenious manner. Oil is drawn from the gearcase through a coarse spiral cut on the small end of worm shaft. At the point in the bearing where this spiral stops, a small hole is drilled, the other end of which is connected to a short length of tubing. Lubricant is fed through the hole and thence through the tubing which carries it up and spills it upon the face of the segment, *h*. From this point the oil runs through small holes in the side of the groove for the tongue and is spread evenly over the surface by the reciprocating motion of the circular rack.

Thus a simple but effective oil pump is utilized to keep the tongue and groove lubricated at all times.

A problem in packing was introduced by the agitator shaft, inasmuch as it was very necessary that no water be allowed to run down this shaft into the gearcase. Development of a seal to insure perfect protection brought about the adoption of a 16-inch length of ¼-inch flax packing with a rubber center. This is coiled and compressed under one ton pressure to 2 inches of shaft length. A spring take-up keeps a close fit at all times.

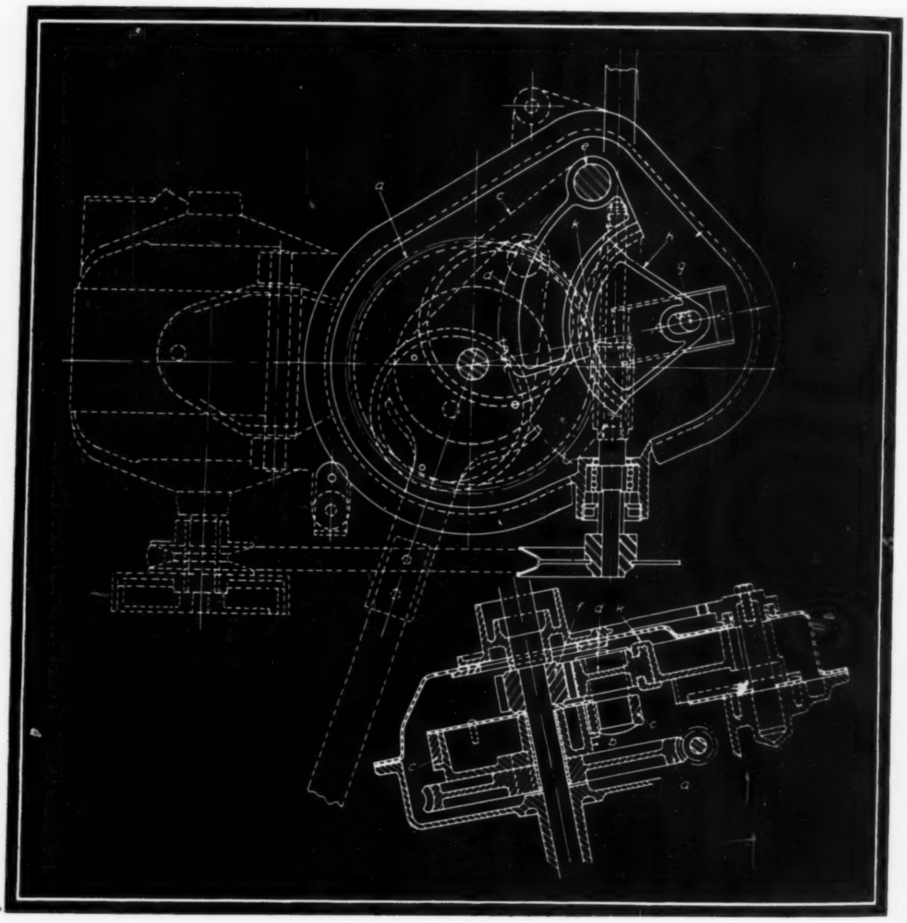


Fig. 3—Mechanism employed in operating the agitator and shifting the circular rack into engagement

In order to provide an adjustment for the belt tension which could be operated with facility by persons not mechanically minded, the motor which drives the worm is suspended from a hinged and rubber insulated plate, Fig. 4, and tension on the belt is corrected by changing the position of the motor around its hinge. An adjusting flange extends to the gear housing where it is secured by a wing nut, Fig. 2. Under the end of this flange is a spring which holds the entire assembly firmly. Tightening or loosening

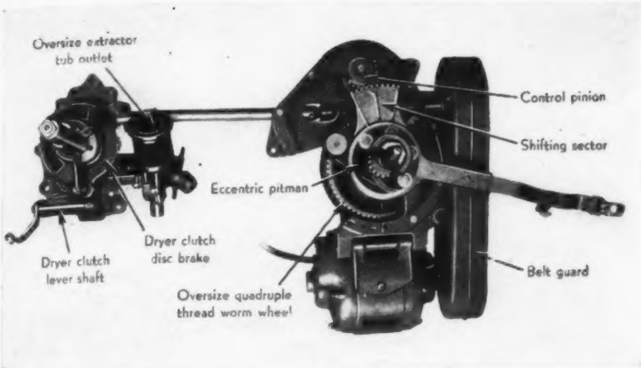


Fig. 4—Washer mechanism from the top, with the tubs and frame removed

the wing nut will adjust the belt to the proper tension.

Elimination of the danger of the operator becoming injured by contact with moving parts, an important consideration in this type of machinery, is accomplished in the drier mechanism by arranging the extractor cover and control lever so that the mechanism cannot be run while the cover is open. The design of the cover is such that it prevents turning the control lever to the starting position when the cover is in any position except closed over the extractor. Raised flanges which close up inside the bead of the top frame impede the motion of the lever when the extractor is open. Operation is through a disk clutch brought into contact by a starting lever.

Perforations in which delicate fabrics might bulge and be torn are eliminated in the design of the extractor basket which is a polished and plated zinc die-cast basin riveted to a deep drawn tapered aluminum shell with a rounded flange opening at the top. This shell has vertical water grooves which are open at the junction of the base and shell. The smooth rolled flange opening further enhances the safety of the mechanism by obviating any possibility of injury to the operator's hands or wrists should they come in contact.

In order to create a revolving mass operating on the gyroscopic principle, the extractor is weighted at the base while the center bearing rises in the middle of the extractor basin where it affords a deep cap on the diving bell principle over the leak proof bearings. The load centers itself automatically with weight of clothes and water around and below the center bearing thus permitting the extractor to revolve evenly at full speed (900 revolutions per minute) and load without vibration or pulsations. This design requires but a single bottom bearing for proper support.

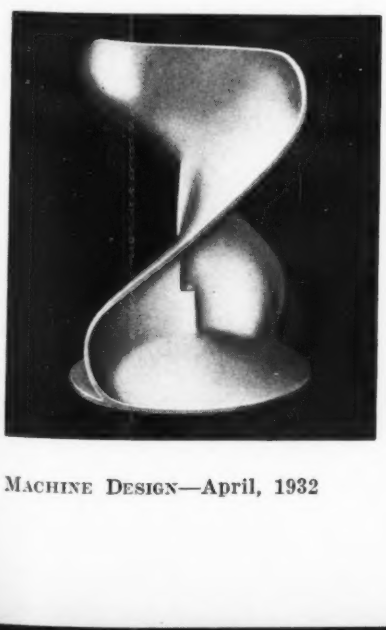


Fig. 5—Double dasher, or agitator, which imparts an unusual motion to the wash and the water

Vibration is further eliminated by the mounting of the washing and extractor tubs, of heavy gage pressed steel, on nine rubber cushions. The tubs are held in position by a rubber tub ring rested in the top frame and compressed by six frame tie rods which are screwed into the top frame and bolted through the bottom or main frame. This makes a nonweaving construction of the utmost rigidity.

Appearance of the machine, another important factor particularly when sales must be made in the general market, has been specified carefully. No exposed angle iron frame or stay rods are visible while all lines blend into the finished design. The extractor and washing tubs have one ground coat of dry process enamel and three coats of white finish enamel while other parts are finished in light green. In the top frame and similar parts, the natural appearance of the metals used is employed, enhanced by high polish on exposed portions.

Mechanism Unchanged in All Models

In relating this washer to the many others in the line of the company, design economy is effected by using identical operating mechanism for the agitators. The difference in price and quality is arrived at by the addition of accessories or in the change of body styles much in the manner of the differences encountered in the design of various automobiles in a manufacturers' line. For example, the model shown in Fig. 1 has decorative paneling around the washing tub which also provides an insulating space of air. This insulation aids materially in the operation of the machine by keeping the wash water at a higher temperature, but another model may be built without it and thus effect a saving in cost.

Other changes designed to meet market requirements may be the substitution of a wringer for the drier, change in various smaller parts of the machine, substitution of different castors and other factors, all of which have a definite bearing on convenience or appearance of the finished machine, but still do not effect its utility in washing clothes. Such alterations enable the manufacturer to produce a large line of equipment for any market while the design of the actuating mechanism remains practically unaltered in all models.

Higher Gearing Ratios Mean Higher Losses

By W. H. Himes

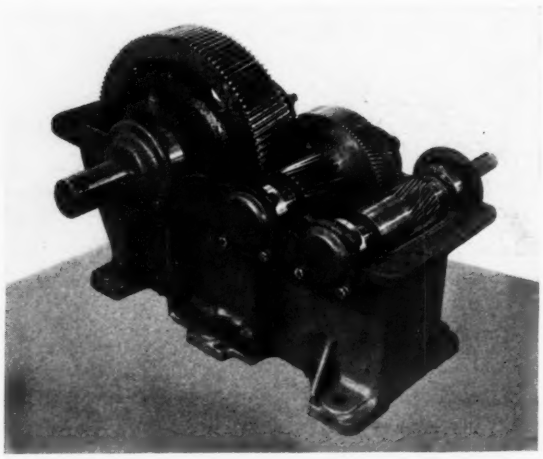


Fig. 1—Typical parallel shaft reduction unit

HOW efficiencies of worms and parallel shaft gearing vary and how these efficiencies are associated with ratio was shown in a general way in the February issue of MACHINE DESIGN. One point not generally appreciated was brought out, namely, that in the use of worm gearing for high ratios a startling improvement in efficiency may be secured by resorting to a double reduction. Thus by reference to Fig. 3 it will be seen readily that when a 50 to 1 ratio is desired, a single reduction worm drive might be prohibitive in its losses; say 50 per cent efficiency. But if it is proposed to pass a constant flow of power through such a reduction, it might be well to provide two reductions of 7 to 1. Each of these could be expected to deliver 94 per cent of the power applied. $94 \times 94 = 88$ per cent overall efficiency. This constitutes a tolerable condition. Also a simple and less expensive expedient would be to use a 10 to 1 worm drive in connection with a 5 to 1 spur or helical drive. The overall efficiency of such a drive would be about the same as the former.

When large reduction ratios are involved, the matter of efficiency may take some surprising turns. Suppose a reduction of 1000 to 1 is required and worm drives are considered; a single worm reduction would mean a gear with 1000 teeth. It is not practical to produce a single thread worm with high enough lead angle to give best efficiency, and the gear with 1000 teeth would involve unwieldy proportions. The next step in the consideration should be a double worm reduction consisting of two steps of 31.6 to 1. A ratio of this type works out in good practical dimensions for a single thread worm having a lead angle of about seven degrees. Such a worm drive can be built to give an efficiency, including bearings, of 65 to 70 per cent. Taking the average as 67 per cent an overall efficiency of the double reduction of 67×67, or 45 per cent is obtained.

Now, considering a triple reduction to gain the same end, each drive will have a ratio of the cube root of 1000, or 10. This ratio brings the worm gear design into the range of its highest efficiency. Many engineers would consider 94 per cent efficiency too conservative a rating for such a ratio; but the writer has tested a worm unit having this efficiency and so feels on safe ground in discussing it. The combined efficiencies will be $94 \times 94 \times 94 = 83$ per cent. Thus by substituting a triple reduction for a double the overall efficiency has been nearly doubled. Any further multiplication of steps would lead into a debatable zone.

The foregoing furnishes an illustration of the law of diminishing returns. The multiplication of units pays dividends up to the triple set; on the other hand, if spur or herringbone drives are

IN any gear unit there are starting losses which exceed the running losses. Mr. Himes, manager, engineering department, Westinghouse Nuttall works, points out in this second of a two-part series, the first of which appeared in the February issue, how starting loss tests may be interpreted. He also makes pertinent reference to the relation between noise and efficiency of gearing.

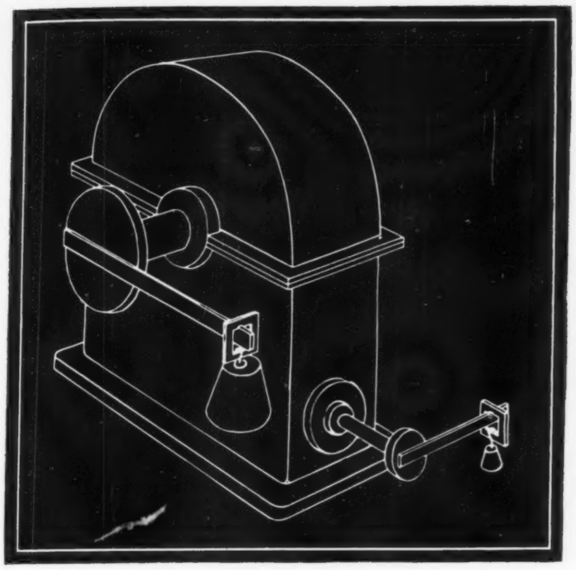


Fig. 2—Set-up of worm gear unit to be used for obtaining static efficiency tests

considered only a slight difference in efficiency is found, regardless of the number of reductions. If the workmanship and design are good, the efficiency will be uniformly high, although it will fall slightly as the ratio increases.

Investigation of Static Efficiency Valuable

So far the discussion has been confined to running speed conditions. There is a zone however which has proved valuable for investigation, and that is the condition at the moment of breaking from rest. For want of a better name, it is called "static efficiency." Any engineer experienced in such matters knows that running tests become erratic and difficult as the speed drops near to zero. It was realized early that some other method of attack was necessary if anything reliable was to be learned about this critical moment. The importance of such reliable information cannot be disputed. No such transmission system ever can achieve normal running conditions without breaking from rest, and, while it frankly is admitted to be momentary, it must be overcome or the machine will never start.

The method of obtaining these data requires no more apparatus than can be supplied by the average millwright. Common coupling flanges can be put on the ends of the intake and output shafts of the train to be tested. A lever then can be bolted or clamped across the face of each flange in the horizontal position, Fig. 2. Of course the one on the power shaft must be much longer and stronger than the one at the high-speed end. The two levers must extend in such relation to each other that the torques developed will be opposed to each other. Weights are then hung on the ends of the levers of such amounts as to cause a theoretical balance of torque.

Thus, if the gear ratio is 10 to 1, the torque applied to the power shaft must be ten times that applied to the motor shaft. In this instance, the high-speed shaft might have a lever two feet long and carry a weight of 40 pounds, thus developing a torque of 80 pounds feet. The low speed lever might be five feet and would carry 160 pounds in order to develop 800 pounds feet. Under these conditions no motion will result; the two levers will be in static balance. However, if increments are applied cautiously to the motor shaft weight, a total will be reached where the lever will start to drop, indicating that the internal static friction of the unit has been overcome. A few repetitions can be made to establish the accuracy of the observation of the critical weight. If the increment now amounts to one pound, the total weight necessary to produce rotation is 11 pounds, giving a ratio of theoretical weight to actual of 10 to 11, about equivalent to 91 per cent static efficiency.

This test should be repeated with varying loads on the power shaft lever. Then a chart of efficiency against load may be plotted. It is not unusual to find these curves reaching a maximum at a moderate load and dropping as the load is increased. This dropping of the curve is taken to indicate overloading, probably manifesting itself in deflection of shafts and other parts, causing misalignment of bearings and gear teeth. Of course if this drop occurs within the rating of the unit, it can mean but one thing—a weak construction.

Just what then is learned about the perform-

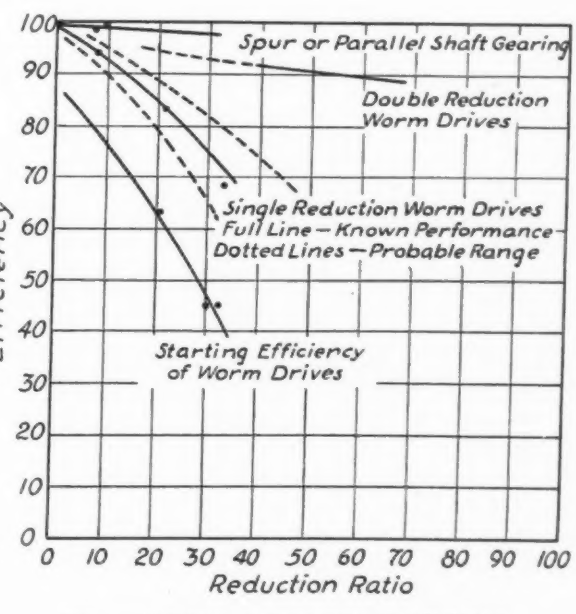


Fig. 3—Relation of gear ratio to efficiency

ance of the gear set? Part of the interpretation is negative. The efficiency so observed is the lowest that the set will manifest under any condition.

In case of a spur or similar drive mounted on

antifriction bearings, the efficiency observed by the static method will be only one or two per cent below the maximum running efficiency and an accurate approximation to this running efficiency can be made. In case of sleeve bearing

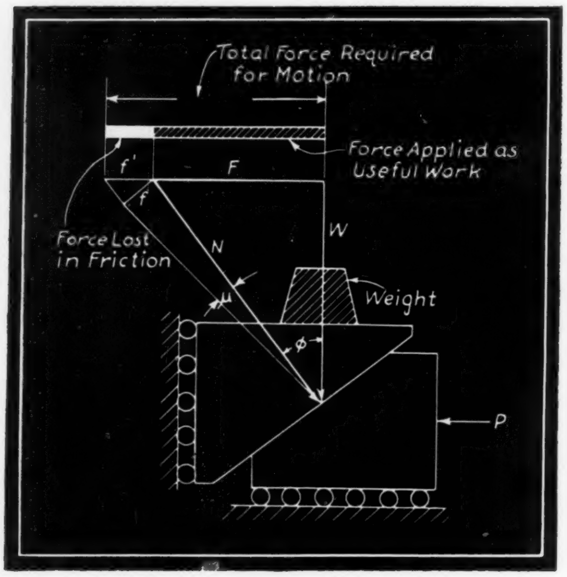


Fig. 4—Stress diagram comparing worm thread and a gear tooth to two mating wedges

units or worm drives, when the static efficiency readily may be as low as 70 per cent, the running efficiency can be approximated by the rough rule that the running loss will be about one-third of the static loss. In other words, if the static efficiency proves to be 70 per cent, the loss is 30 per cent, and the running efficiency will be about 90 per cent. Of course the details of construction will modify this ratio, but frequently such an approximation will be close enough for the requirements. As already pointed out, this simple test is applied quickly and needs no other apparatus than that available to the average millwright.

Excess Starting Torques Present

The most important consideration in regard to the figures so attainable is in connection with the starting torque developed by the prime mover. One might make an elaborate running test of a given unit or train and select a motor in accordance with the running efficiency observed, only to find that by ignoring the starting conditions the motive power chosen was inadequate to start the load. The immediate reaction is that electric motors have an excess starting torque more than sufficient to meet this difficulty. However, many types of load driven through reduction gears, involve heavy starting torques in themselves. The full starting capacity of the motor frequently is required by the load itself and in such cases, and also where other prime movers such as gas engines are used, an extra and unexpected loss in the gear train will prove embarrassing to the designer.

That higher lead angles are associated with higher efficiencies is not at all obvious from superficial considerations; on the contrary, it seems to present a paradox. The lower the lead angle the more easily the worm moves the loaded gear, and certainly with less thrust bearing loss on the gear shaft. The physical explanation is made more readily by means of a stress diagram. In Fig. 4 the worm thread and a gear tooth to two mating wedges are compared. The upper wedge represents the gear tooth, and associated with it is the weight, W. Lifting this weight will correspond to rotating the power shaft under load. The lower wedge represents the worm thread. The circles represent thrust bearings. These two wedges are so disposed as to move only at right angles to each other, just as the worm and gear rotate in planes at right angles to each other. In this first figure, the inclination of the wedge surfaces corresponding to the lead angle of the worm is assumed to be high.

The vertical vector representing the weight

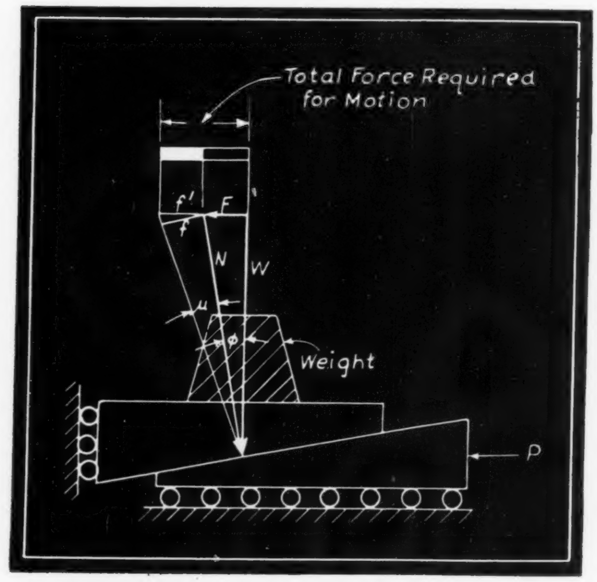


Fig. 5—Conditions of stress with a low lead angle worm is shown by this diagram

to be moved may readily be resolved into two components, the normal pressure, N, resulting from the weight and the horizontal force, F. Assuming that friction in the thrust bearings is a negligible quantity, as it is in reality, the vector F measures the force which must be applied at P to maintain equilibrium and prevent the lower wedge from being displaced.

To find how great P must be to produce motion and so do work, a friction angle μ must be assumed in accordance with known practice. For the sake of clearness in the diagram, this has been made excessive. The force of friction will be parallel to the surfaces producing it, and will be opposed to the direction of motion of the

weight. Thus f is found parallel to the rubbing surfaces. Force can be developed only in the horizontal direction so f is projected upon the horizontal line and f' the horizontal force necessary to overcome f is determined. Thus the total force required to produce motion is $F + f'$. It is admitted that this is an approximate solution, but it is clearer for the purpose than a more precise one. From this solution it can be seen that while the useful work of raising the weight W is in proportion to F, the total applied effort must be in proportion to $F + f'$. The efficiency therefore is $F/(F + f')$. Owing to the high lead angle chosen, the value of the expression is high, say 75 per cent, in spite of the exaggerated friction loss chosen for the diagram.

Relative Magnitudes Can Be Varied

While the friction or loss is constant with given conditions, (friction loss), the relative magnitude of F and hence the ratio between F and f may be varied at will by changing the angle ϕ which is the lead angle of the worm. Therefore, the efficiency is a function of the lead angle and is increased by increasing the lead angle. In Fig. 5 is shown a diagram similar to Fig. 4, except that the inclination of the wedges is assumed much less in order to represent the conditions with a low lead angle worm. The formula for efficiency will be the same as before, but

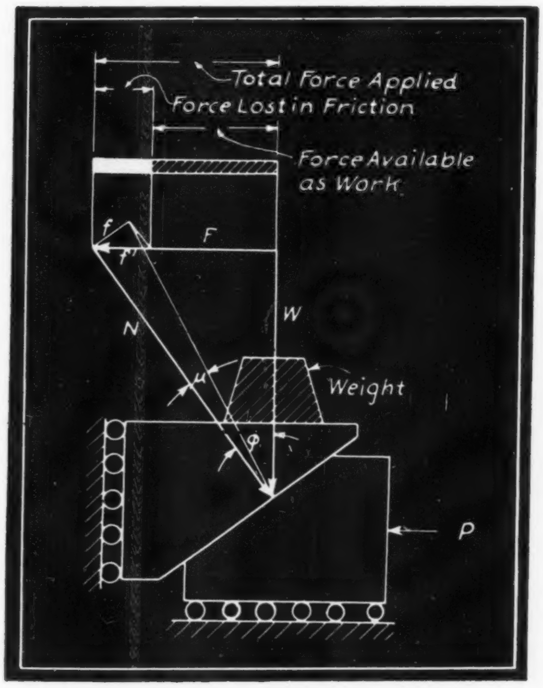


Fig. 6—Stress diagram with the gear used as the driver and the worm the driven member

since the lead and friction angle have been chosen the same, the vectors representing the static sustaining force and the friction loss are of equal magnitude so that the expression for e, $F/(F + f')$, has dropped in value to 50 per cent.

Suppose now that it is desired to reverse the drive, not the direction of rotation, but let the gear be the driver and the worm the driven member. In the illustration then the weight, W, produces the power and as before, Fig. 6, the same condition for equilibrium will be present, but as the tendency of motion will be in reverse, the friction vector will be in the opposite direction. It will be subtractive and the useful work available will be $F - f'$. The efficiency will be $e = (F - f')/F$. It is interesting to observe that this expression probably is less than the previous one,

$$e = \frac{F}{F + f'}$$

because

$$\frac{F}{F + f'} > \frac{F - f'}{F}$$

reducing to common denominator

$$\frac{F^2}{(F + f')F} > \frac{F^2 - f'^2}{(F + f')F}$$

or

$$F^2 > F^2 - f'^2$$

From which it is determined that when used as a step-up mechanism the unit will be less efficient than when used as a speed reducer. This is in accordance with the general belief of gear men, although it has not been widely demonstrated.

Mechanism Is Self-Locking

It is well known that drives of 50 per cent or less in efficiency are not reversible. The diagram, Fig. 5, was drawn for 50 per cent efficiency, and it is obvious that such a mechanism is self-locking, because when the friction vector is reversed, as in the case of Fig. 6 just cited, it will be of equal value to the available power vector and of opposite sign. It will, therefore, completely cancel it, leaving nothing for useful work.

No discussion of efficiency in connection with gearing would be complete without some comments on the relationship between efficiency and noise. There is a prevalent belief that quietness and efficiency go hand in hand and that, conversely, much clatter and noise must be accompanied by high losses. It also is asserted frequently that noise must be a sign of deterioration or wear and that there is nothing to fear from wear if the gear runs quietly. There is really no foundation for this conviction; in fact the reverse is more apt to be true. The fact is that there is no relationship nor ratio between noise and efficiency or wear. Hardened gears that were an offense to the ears have kept running year after year—apparently indestructible and highly efficient, while a set that began to abrade each other from the start under light load, were running smoothly and quietly. A low lead angle worm drive having less than 20 per

cent efficiency will run with absolute silence, while a chain drive, known to be highly efficient, may clatter violently. If the designer is seeking evidence on efficiency without scientific weapons, he should not spend any time listening, but should feel for heat.

One other point which has been hinted at before, is that of lubrication and efficiency. It takes power to churn lubricating oil in a closed case. It is entirely possible and too frequently accomplished, to fill a gear case so full that the churning of the excess oil will raise the temperature of the entire case to the danger point. The general assumption of the maintenance man is that if a little oil is good, a lot is better, or at least will do no harm. So when the new unit is installed the manufacturer's instructions are ignored and the case frequently is filled nearly to the journals. The result is not only loss of power transmitted, owing to the work of churning the excess oil, but overheating besides. There is always some one gear in a splash-lubricated case which turns fast enough to throw the oil into the splash troughs. The level should be such that this gear dips only slightly into the oil. This condition gives good efficient distribution to the bearings without heating losses. There probably is no manufacturer of gear units who has not had to send a trouble man to service units that run hot because of disregard for this.

To recapitulate: Efficiency of parallel shaft gears is much nearer 100 per cent than generally is supposed and usually is higher than that of worm drives. Efficiency of worm gears is more sensative to ratio than is the former type. The higher the ratio, the greater the loss in any type of gear. Efficiency has no bearing on noise. There are always starting losses exceeding the running losses. These losses are greater in sleeve bearing units.

Compounded Rubber Resists Acid Immersion

CONTRASTING strangely with the liveliness exhibited in the physical reactions of rubber, a distinct lethargy is found in respect to chemical reactions, an inertia which renders the material of unique value in certain engineering applications. It is apparent when the manifold uses of rubber as a chemically-resistant material are studied, that its value in the majority of cases depends not only upon the chemical inertia and peculiar physical properties of the basic substance but also upon the fact that this basic substance has been combined intelligently with a variety of other materials. Too much emphasis cannot be placed upon the fact that rubber compounds are designed for specific uses; and that they can be bonded to many other structural materials with practically integral adhesion, accordingly to H. E. Fritz and J. R. Hoover of the chemical sales division, B. F. Goodrich Co., Akron, O.

Vulcanized Material Is Used

When the conditions of service are accurately known by the manufacturer, vulcanized rubber can be compounded to resist actual immersion for long periods in any of the inorganic acids except those of strong oxidizing character. The same is true of nearly all inorganic salts and alkalies, and, to a somewhat more limited extent, of commercial organic materials.

Outstanding exceptions to the general chemical inertia displayed by properly designed rubber compounds toward inorganic materials are nitric acid, concentrated sulphuric acid, chromic acid, and the dry halogens.

In the organic field, it is found that rubber is swollen and deteriorated—in various degrees depending upon the material considered and the design of the rubber compound—but nevertheless adversely affected by nearly all liquid fatty acids, drying oils, cyclic aliphatic liquids, and aromatic solvents. Especially severe are the affects of such solvents as benzene, carbon tetrachloride, ethylene dichloride and carbon disulphide, the latter being the worst. Mineral oils and greases seriously affect most soft rubber, but are resisted satisfactorily by true hard rubber, and by some flexible hard rubber compounds. In general, it can be stated that hard rubber is much superior to soft in its resistance to those materials.

Great strides have been made recently in compounding rubber to resist the action of oils, greases, fats and organic solvents; and to resist the serious deteriorating effects of high temperature service (up to 250 degrees Fahr.) It must be recognized, however, that these are

WHEN combined with other materials, rubber can be developed which has chemical and physical properties that give it an unusual advantage for use in process equipment. The accompanying abstracts are based on a symposium on rubber conducted by the American Society for Testing Materials in Cleveland at which the newer developments in this versatile material were presented.

serious causes of deterioration even with the best of modern compounds; and that the successful use of rubber in such service depends rather upon unique physical properties of the material, and the lack of better materials, than upon inertness to these factors of limitation.

In discussing limitations, it is of interest to note that pure water affects rubber more seriously, especially at elevated temperatures, than do most of the solutions enumerated above. This is apparently due to molecular diffusion and therefore is retarded markedly by the presence of electrolytes.

When pure water swells soft rubber dissolved oxygen carried into the rubber undoubtedly plays an important part in the resultant deterioration. The same is true of the rapid deterioration encountered when rubber is swollen by oils. In both cases, hard rubber is found to resist diffusion, absorption and swelling incomparably better than soft.

Recognizing certain distinct advantages and certain limitations in each type of rubber, soft and hard, for chemical service under conditions of variation in temperature, liability of shock, impact or gouging, and abrasive wear, technologists have produced a practical construction which successfully combines the two types. In this construction, a layer of hard rubber is cushioned between two layers of soft rubber with

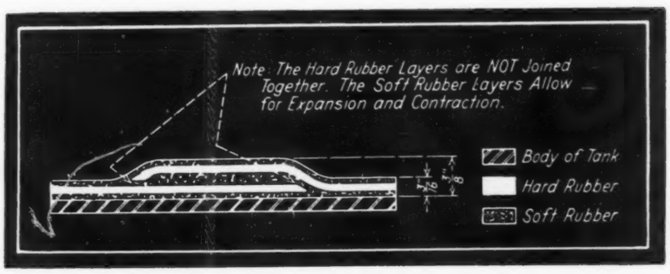


Fig. 1—Typical joint of lining for process equipment which employs layers of hard and soft rubber

suitably spaced overlapping expansion joints that effectively prevent cracking or buckling of the hard layer under expansion and contraction with temperature changes. Fig. 1 illustrates the principle involved.

This combination can be bonded to steel and certain other materials and finds its chief application in lining tanks and other process equipment in chemical and allied industries.

The three-ply construction has proved remarkably immune to physical damage by shock, impact or gouging. In addition, it combines the resistance of true hard rubber to chemical and solvent action, diffusion and absorption, with the resilience and wear-resisting qualities of the soft rubber face layer.

It will be well to emphasize to engineers who

Table I

Permeability, Relative to Hydrogen, of Rubber to Gases

Class I. Gases Soluble in Nonrubber Constituents.	
Liquid water	105.00
Water vapor	55.00
Gaseous ammonia	8.00
Carbon dioxide	2.90
Class II. Gases Slightly Soluble:	
Air	0.23
Helium	0.65
Hydrogen	1.00
Class III. Gases Soluble in Rubber:	
Methyl chloride	18.50
Ethyl chloride	198.00

propose to use rubber the necessity for accurate definition of service conditions and requirements. It is only through intelligent co-operation between the engineers using rubber and the engineers designing it that the best advantage can be taken of this unique engineering material.

In discussing the "Resistance of Rubber to Water and Gases," R. H. Gerke, development department, U. S. Rubber Co., Passaic, N. J., brought out the fact that when one thinks of gas permeability in connection with rubber, the first thought is perhaps of helium or hydrogen in balloons and airships. Gold beaters' skin is superior to rubber in that service but during the World war rubberized fabrics were used in balloons. It has been stated that fabrics which are covered with layers of rubber and gelatin or glue-like materials are still less permeable. Nature has made rubber more resistant to passage of air than of hydrogen or helium.

Relative Permeability Shown

In Table I is shown the relative permeability of rubber to various gases, which exhibit different degrees of solubility in the rubber constituents. Water soluble gases are very penetrating, gases slightly soluble in rubber constituents are least penetrating, and rubber soluble gases are most penetrating.

It seems pretty well demonstrated that the purer the rubber hydrocarbon the greater is the resistance to water. The nonrubber constituents of crude rubber lessen the waterproof qualities; thus a highly purified rubber absorbs water one-seventieth as fast as ordinary pale crepe.

When vulcanized rubber is soaked in water the water absorption is less the higher the degree of vulcanization. After vulcanization, the rate of absorption of water increases 1.32 to 1.44 fold for each 10 degrees Cent. rise in temperature. In general, rubber is protected from deterioration when kept submerged in a moist condition, since the deleterious action of oxygen is reduced considerably.

Overcoming Troublesome Conditions in Cam Follower Design

By John Flodin

THE ordinary cam follower, which is apt to be troublesome from the standpoint of strength and lubrication when the combination of load, pressure angle and speed is unfavorable, may be treated mathematically with a fair degree of accuracy.

From the layout of the cam effective or longitudinal forces, P, Fig. 1, usually are definitely known for different positions of stroke, and so also are corresponding magnitudes of pressure angle α. From Fig. 1 it is clear that the actual or gross load on the follower roller is $W = P \div \cos \alpha$. W is thus a function of two variables, the effective force and the pressure angle.

Designing the Roller and Pin

It often is most convenient to start the design with a tentative determination of the roller pin, which may at first be figured for shearing strength only, the questions of bending strength and bearing being left for later consideration. The condition of service of the pin is, of course, comparable to that of a nonrotating shaft.

Since length of pin cannot be less than that of the roller, length of roller, which is in part dependent on the diameter and on the surface speed, must first be determined.

Let

d = diameter of roller, inches

l = length of contact surface between roller and cam face, inches

v = surface velocity of roller, inches per minute

Then[1]

$$d^2 \times l = \frac{Wv}{960{,}000} \text{ for hardened steel}$$

and

$$d^2 \times l = \frac{Wv}{420{,}000} \text{ for unhardened machine steel}$$

Where pressure angle α is not large, the surface speed v of the roller may be taken with sufficient accuracy as $2\pi rN$ where r is radiant of the cam for the position under consideration.

To permit use of formulas given in the foregoing, in which quantities d and l are interdependent, the tentative pin diameter already decided on may be used. It is well to make roller diameter not less than twice pin diameter, and it is a saving of time to be generous with the roller diameter since it is quite likely that pin size must be increased.

To illustrate, let it be assumed that at a certain point of the stroke of a cam follower the force P to be transmitted is 800 pounds, that pressure angle α is 15 degrees, that effective radiant of the cam is 3 inches, and speed is 100 revolutions per minute. Roller and cam face are to be hardened steel.

The gross load $W = 800 \div \cos 15$ degrees $=$ 830 pounds.

Allowing a shear stress in the pin of 6000 pounds per square inch and neglecting for the present bending and bearing considerations, the pin diameter must be not less than

$$d = \sqrt{\frac{4}{\pi} \times \frac{830}{2 \times 6000}} = 0.297 \text{ inch}$$

The pin probably should be made $\frac{3}{8}$-inch diameter, and the roller, 1 inch diameter. Surface velocity of roller and of cam is

$$v = 2\pi 3 \times 100 \div \cos 15^\circ = 1955 \text{ inches per minute}$$

so that

$$d^2 \times l = l\ \frac{830 \times 1955}{960{,}000} = 1.7 \text{ inches}$$

This quantity, 1.7 inches, thus is the length of the contact line between roller and cam face, but if the roller itself be made 1.7 inches long, and the pin $\frac{3}{8}$-inch diameter, the bearing area becomes only about 0.638 square inches, which is low. The cam face therefore may be 1.7 inches wide, but either the length of roller or pin diam-

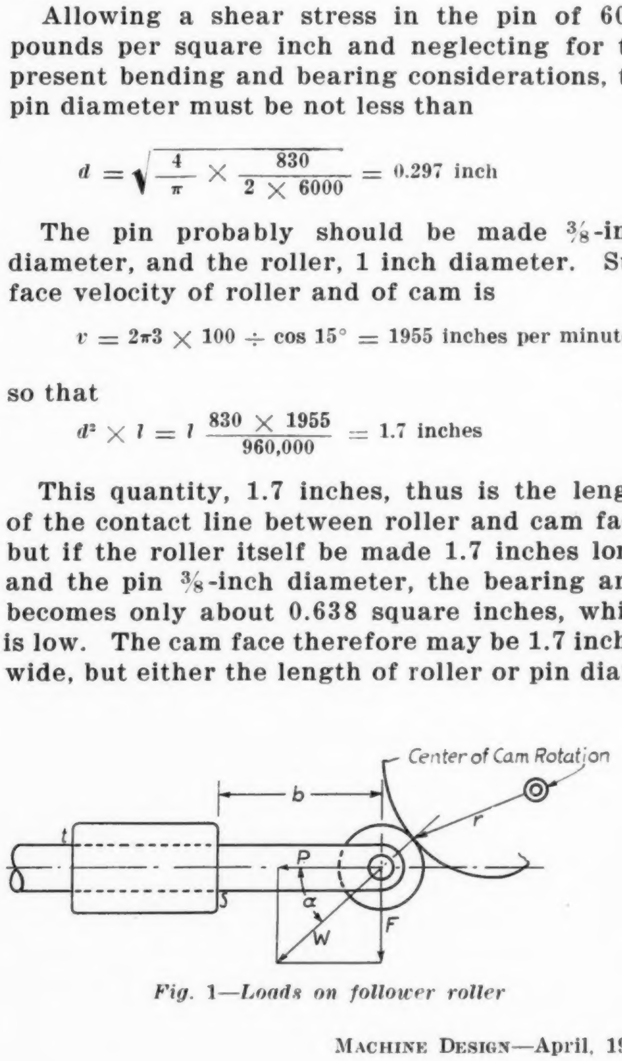


Fig. 1—Loads on follower roller

[1]These formulas may be recognized as being taken from an old set of experiments. The constants given have been worked out from cams in service. The results they give are well on the side of safety, and where lubrication is reliable and lightness a factor, they may be shaved by perhaps 15 or 20 per cent.

eter must be increased so that the unit bearing pressure is brought down to a reasonable figure —between 500 and 800 pounds per square inch, depending on lubrication.

Finally, it should not be forgotten that diameter of pin should be checked for bending.

The roller shown in Fig. 1 is subjected to a transverse force

$$F = P \tan \alpha$$

F causes bending in the follower shank, which acts as a cantilever whose length may be taken with sufficient accuracy as b. The shank is also subjected to direct compression due to longitudinal force P. In many cases F is small and the product Fb may not give sufficient bending stress to effect appreciably the size of the shank found from pure compression; in other cases

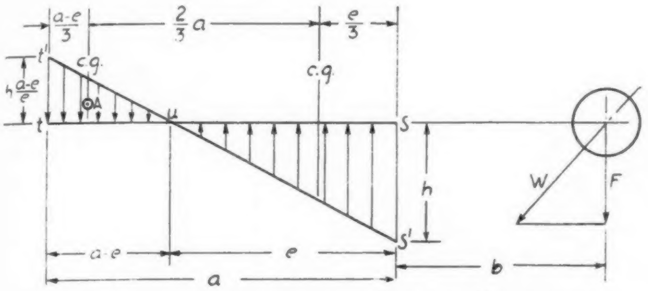


Fig. 2—Diagram showing approximate guide pressures

bending becomes far more significant than compression. The conditions should be investigated carefully to determine the most severe combination of stresses, and since the shank is a moving body subjected to variable and perhaps to suddenly applied loads, a reasonably high safety factor must be used.

Produces Compressive Loads

Whether or not force F effects the size of follower shank, it obviously produces compressive loads on the guide at s and t. These guide pressures are opposite in direction, are maximum at the two points shown, and decrease toward the middle of the guide. If the shank fitted freely into the guide, there would be a distance about at u, Fig. 2, where no guide pressure would exist, a distance without contact between shank and guide. But with reasonably small clearance and accurate workmanship the gap becomes negligible and the conditions approach those shown in the diagram, Fig. 2.

This diagram is based, for simplicity, on the assumption that compressive guide forces vary in direct ratio as their distances from u, the point of zero force. This assumption makes line $s'\,ut'$ a straight, continuous line, giving force triangles which are easy to deal with, and the error introduced is negligible due to the fact that consideration must be given bearing pressures which at best are only rough approximations taken from practice.

In the figure, triangle uss' represents upward forces which must equal the sum of the downward forces, or F plus the forces represented by triangle utt' Thus

$$(1/2)\ he = F + (1/2)\ h\ \frac{(a-e)^2}{e}$$

Also, the effects of forces represented by the triangles may be taken as concentrated at centers of gravity of the triangles. Taking moments about A, which is the center of gravity of triangle utt'.

$$(2/3)\ a \times (1/2)\ eh = [(2/3)\ a + (1/3)\ e + b]\ F$$

Solving both these expressions for e and combining,

$$a^2h = 4aF + 6bF$$

from which

$$h = \frac{4aF + 6bF}{a^2}$$

and

$$a = \frac{2F + \sqrt{4F^2 + 6bhF}}{h}$$

The value h represents maximum total sliding pressure over the width of slider or shank. Thus if the shank is made ¾-inch wide on the basis of stress considerations, and if it is desired to limit the unit bearing pressure to 200 pounds per square inch, a rather high value, h must be made 200 by ¾ or 150 pounds. Substituting this quantity in the last equation would then permit solution for a, the length of guide which, for a width of ¾-inch, would make the unit bearing pressure 200 pounds per square inch.

If on the other hand length of guide, a, is fixed by the machine, the value h should be found, and it then may become necessary to increase the width of guide and shank to keep bearing pressure down.

Adopt New Belting Standards

MANUFACTURERS of leather belting have discarded the former standard of ounces per square foot for specifying belting, and have chosen instead a thickness standard by which all belting will be specified and sold. The old weight terminology might be varied by the mere addition of weighting materials to the leather and did not represent necessarily a differential in transmission values. This decision was reached after the American Leather Belting association had canvassed all manufacturers of belting throughout the country, with the result that 81 replies were received, all voting for the change.

The thickness specifications now in effect for first quality leather belting are stated as:

Medium single	10/64 to 12/64 inches
Heavy single	12/64 to 14/64 inches
Light double	15/64 to 17/64 inches
Medium double	18/64 to 20/64 inches
Heavy double	21/64 to 23/64 inches

MACHINE DESIGN

Editorial

Steady Business Cannot Be Maintained on Sales Features Alone

ONE of the results of the present business situation is an increasing tendency on the part of manufacturers to look for new products. Many companies are scouting around for opportunities to add profitable side lines which are adapted to their existing plants.

A case in point concerns a machinery company of good reputation and broad experience. Its president discovered a promising piece of equipment which was about to be put into production by a small company in a distant city. After ascertaining that the rights to this product could be purchased reasonably, he sought the advice of his sales manager. Following a brief investigation of the marketing possibilities, and with the enthusiastic approval of the sales chief, the president closed the deal and ordered drawings, dies, castings, parts, etc., shipped to his own plant. In due course production was established and within a short time more than 50 units were sold and installed.

And then trouble ensued. Complaints came from numerous purchasers. The equipment was proving faulty in service. The company investigated promptly. The engineering department, which up to this time had been ignored, was put on the job of ferreting out the difficulty. It was found quickly, but before the company had emerged from this trouble, the machine had been redesigned almost entirely.

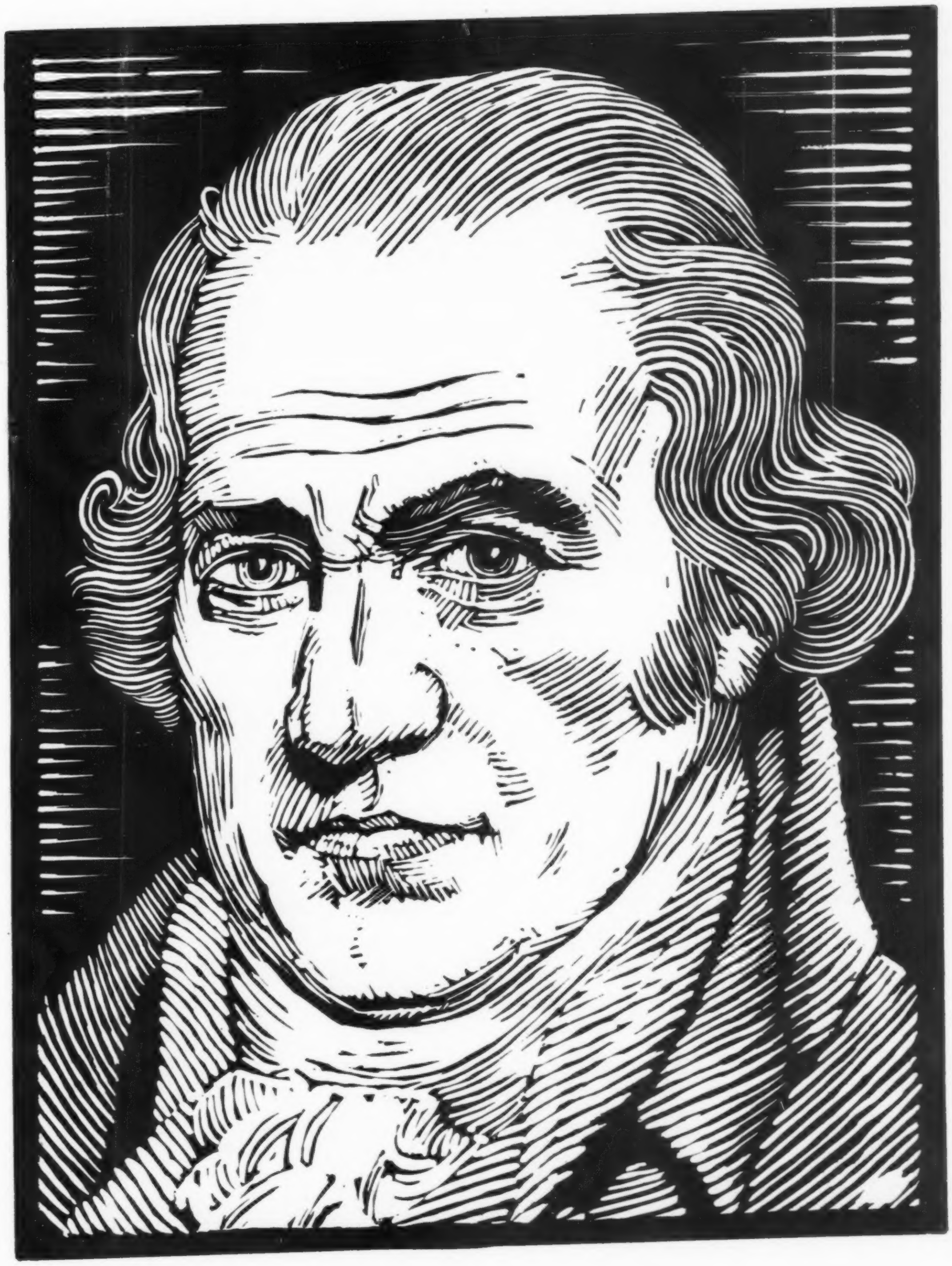
The lesson to management is obvious. When taking over a new line for manufacture do not fail to consult your chief engineer and your shop superintendent. They may be able to save you from considerable grief.

Creation of Demand

OF THE machinery manufacturing companies that have met with varying degrees of business success during the past two years, builders of household equipment hold a commanding lead. Sales of domestic refrigerators, oil burners, electric clocks and air conditioning apparatus have shown steady increases.

Which goes to show that though industry continues to economize, the public still can be attracted to the point of purchase by radically new lines. No better example of this could be found than creation of demand for the Ford eight, definite orders for 85,000 of which it is claimed were placed before production started.

It is such creation of demand that is enlarging the domestic machine field and it is just such creation of demand that should constitute the primary objective of engineers responsible for design of other classes of machinery. Today is not the day for traditional design!



James Watt

Master Designers

James Watt

A SINGLE machine potent enough to instigate an industrial revolution is a gigantic leap in design, but when this development is entirely the work of one man it becomes even more remarkable. The steam engine perfected by James Watt, born in Scotland in 1736, did more to change history than any other invention, any war, or any treaty. The engine as it is known today differs only in minor details from the complete machine Watt evolved.

THE outstanding trait in this designer's character, by trade a mathematical instrument maker, was his application of critical effort which he followed with the evolution of new syntheses. The development of the steam engine would have been delayed for years had not Watt applied this trait to a Newcomen engine he was repairing. He determined the inherent weaknesses of the device, and continued his efforts until there was nothing further he could do to improve it.

NEVER was a machine needed more urgently. The original Newcomen engine and other methods of providing power were too expensive or pitifully inadequate. By his invention of the separate condenser he found the key to the entire problem. His principal difficulty lay in the fact that he had outstripped manufacturing facilities. Financial and patent troubles were obviated during the latter stages of development by his association with Matthew Boulton.

WATT invented a machine for drawing in perspective, the centrifugal governor, a machine for copying letters and drawings, and suggested the screw propeller. He made complete discoveries of the compound nature of water, and investigated calorific heat. Although in poor health in his early years Watt was marked by his vigorous energy in later life, and at his death, at 83, was engaged in the perfection of a machine for copying works of sculpture.

PROFESSIONAL VIEWPOINTS

Publication of letters does not necessarily imply that MACHINE DESIGN *supports the views expressed*

Comments and Questions from Our Readers. Machine Design Will Pay for Letters or Solutions to Problems Suitable for Publication

Salesmen's Sketches Aid Designers

To the Editor:

RECENT discussions concerning the relations between salesmen, engineers and purchasing agents have helped to clear up many misunderstandings and all concerned have been benefited. In this connection, however, there is one subject that has not received much attention, but which can be made of immense value to the officials included in this grouping. This is the inclusion of freehand sketches with reports and orders.

The salesman who can make a simple freehand perspective sketch which helps to visualize the application of his equipment to a prospect's particular needs certainly has the edge on a salesman who has not developed that faculty. A simple sketch often drives home a point that is missed entirely when merely explained verbally. Often such a sketch has obtained an order.

Another angle to this subject is that a salesman who can make sketches handily can describe a given situation or his customer's requirements to his engineering department more effectively, and in that way avoid unnecessary correspondence and the consequent delay in time.

Several avenues are open to anyone wishing to learn the rudiments of sketching, and it certainly behooves any salesman to give this subject some real study and thought, as without question it pays handsome dividends.

—C. E. SCHIRMER,
Springfield, O.

Standardized Reference for Fastenings

To the Editor:

THERE is a bit of standardization as yet uncompleted that I wish to advocate as it will do much to simplify the specification of a great number of parts. I have noticed that all screws, washers, cotter pins and so on used to construct the average machine vary but little in what can be called "size range;" for instance, a hundred numbers assigned to a standard size list of hexagon head cap screws will cover every requirement from the needs of a meter to that of a gasoline crawler crane.

So why not designate all of the one half—thirteen hexagon head cap screws, one and one-half inches long, as just plain No. 563? Then let that be their designation on drawings, order blanks, the stock bin, the part list, telegrams and everywhere else it might be used.

All that needs to be done is for the makers of such parts to print an adopted series of standard part numbers alongside the description of the sizes they have to sell.

The designer, clerk and stockkeeper will do the rest, at a great saving of time, pencils, ink and words in telegrams.

—R. F. POHLE,
Franklin, N. H.

Compound Cleans Drawings Easily

To the Editor:

CLEANING drawings, preserving them, or pasting them together can be accomplished easily with a compound which I have found to be invaluable in this work. This remarkable compound, which I discovered some years ago while experimenting for another but allied purpose is made as follows: Take some pure gum rubber which comes from supply houses in square sheets about ¼-inch thick; cut up a sheet about six inches square into pieces about an inch square; put this into a quart preserves jar with screw top and just about cover the pieces of rubber with liquid benzol; and let it dissolve until it is of jelly viscosity.

By varying the proportions of gum rubber and benzol a solution of widely varying consistency can be obtained that is of great value for many purposes which will suggest themselves to the user. The mistake should not be made of trying rubber bands thinking they will do as they will not serve the purpose.

For cleaning drawings I commonly use this

solution in a heavy, molasses-in-winter consistency and take a ball of it in my hand and rub it over the paper surface to be cleaned. There is no waste nor loss, and the whole lump can be thrown back into the jar and used over again until it is extremely dirty. When it must be cleaned, let it dissolve down to a watery consistency by adding benzol and let the dirt settle. Then pour off the clean solution, and again let the benzol evaporate to the required consistency.

Brushing this solution in an almost watery consistency over both the front and back of a drawing will preserve paper drawings for years and avoid the inherent paper stretch and shrinkage which soon make an otherwise accurate drawing valueless for scaling and patternmaker's uses. Still another use is for pasting drawings and tracings together without the aggravating crinkle along the pasted edges. Solution somewhat thicker than for waterproofing should be used, and if it is necessary years later to open the joint, it will be found that it can be separated without tearing the paper or cloth if a little care and thought are used.

—JOHN S. CARPENTER,
York, Pa.

Carry Design Into New Channels!

To the Editor:

THE editorial in the February issue of MACHINE DESIGN pertaining to the "Opportunity for Engineers Who Can Carry Design into New Channels" certainly was a bull's eye, and I, for one, hope that it was read by many in the profession. I have seen a practical demonstration of this same principle in the last six months. An engineer, a friend of mine, was one of the type who performed everything by rote and checked all his efforts to the last possible figure; but as business became worse he was faced with the problem of getting out a new design or a redesign of his particular type of machinery or there would be no positions for anyone with his employer.

The result was that he threw caution to the winds and gambled, using nothing but common sense and leaving the long drawn out conferences and extreme figuration out of the picture. Recently his firm came on the market with a radically new type of machine with the result that as far as they are concerned the depression is over. This engineer now says that nothing in the future can ever bind him to a regular routine procedure, but that he will be guided by the common sense that he hopes he has. The majority of our engineers are capable of more than they themselves realize, but do not produce more simply because they have been taught a cautious routine in school and in business and are afraid to break away from it and tackle anything that looks radically different.

—CHARLES R. WHITEHOUSE,
Boston

Simplifying Task of Finding Tracings

To the Editor:

IN DESIGNING new mechanisms or redesigning old ones, the engineer is confronted with the necessity of referring to former methods. He must see previous assembly drawings and standard details. These may be in the form of blueprint books, data sheets or photostats. However, unless a rigid policy of keeping these copies up-to-date is maintained, the tracing usually is resorted to as the latest and safest record.

Two men were employed in the drawing and tracing vault of a large eastern plant. These men, through an elaborate card system, charged out all drawings and tracings taken from the files for which the individual was responsible. Every week the tracings were rounded up, the designer returning them to the vault in a folder assigned to him. These he took out again on Monday morning. This of course was to overcome fire hazard.

In a small or medium sized plant such a system is prohibitive due to expense, and an honor system must be resorted to similar to the metal check system used in the shop. In this case a small card previously printed with the designer's name on it is put in place of the removed tracing. This is not satisfactory, especially for large tracings, because in getting others in the same drawer the card gradually is worked to the back of compartment and obscured. Where the cards are placed in a receptacle, at times possibly several hundred cards must be gone over to ascertain who has that particular tracing.

Where no such system is used the designer wastes valuable time trying to locate the drawing if it is out of its place in the vault. He goes through the design department through the detail department and finally in desperation gets the blueprint boy to root it out for him. It may take an hour a day or maybe two or three days before it is located. Does an honor system exist that cannot be disrupted by the carelessness of a disinterested individual? Has any reader a good workable system, simple and inexpensive, which will eliminate this "button, button, who has the button," method?

—F. A. FIRNHABER,
Waynesboro, Pa.

ASSETS TO A BOOKCASE

Review of Books Pertaining to Design

Faraday the Metallurgist

Faraday and His Metallurgical Researches, by Sir Robert A. Hadfield; cloth, 329 pages, 6 x 9½ inches; 68 plates, 12 illustrations and 27 tables; published by Chapman and Hall, London; distributed in America by the Penton Publishing Co., Cleveland, and supplied by MACHINE DESIGN for $6.50 postpaid.

From 1819 to 1824, before he had discovered the action of electromagnetic induction, Michael Faraday devoted much of his time to metallurgical research. Utilizing the primitive laboratory facilities of the Royal Institution at London and with the assistance of friendly steelmakers in Sheffield, he experimented with steel alloyed with nickel, silver, platinum, rhodium, irridium and osmium, palladium, titanium, chromium, copper, tin and gold.

Until recently comparatively little was known of this phase of Faraday's work. Fortunately, however, a box containing 79 specimens of his steel was discovered and turned over to Sir Robert Hadfield, who has examined them by the methods of modern scientific research. Out of the results of this unusual examination of century-old steels, Sir Robert has developed material for a book of absorbing interest. Entitled *Faraday and His Metallurgical Researches,* it not only throws light on an obscure part of Faraday's eventful life but also establishes the "Father of Electricity" as the rightful holder of the additional honor, "Pioneer of Alloy Steels."

The author reviews the earliest beginnings of metallurgy and traces its development up to the nineteenth century. After describing in great detail his examination of the historic specimens, Sir Robert presents numerous appreciations of Faraday's work, concluding with his own judicial appraisal, which, needless to say, gives great credit to the subject of the book.

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Details of Engine Design

Elements of Machine Design, Part II, by W. Cawthorne Unwin and A. L. Mellanby, cloth, 450 pages, 5½ x 8½ inches; published by Longmans-Green & Co., New York; and supplied by MACHINE DESIGN for $4.00 plus 15 cents postage.

This book which is confined chiefly to engine details (Part I being devoted to general design) recently was revised in order to give the engineer a better understanding of problems created by modern trends in design. The new edition contains all the data which has made its predecessor popular among engineers, and in addition it embodies in its supplemental text matter, a chapter on the torsional oscillation of shafts.

Also typical of revisions in the text is the extension of the discussion on strength of flange joints to include every form likely to occur in practice. In the chapter on link motions, the common features underlying various types have been clarified where experience had shown that the reader might have difficulty in comprehending them thoroughly. The revised issue will no doubt augment the enthusiastic following of the book.

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An Outline of Research

Science in Action, by Edward R. Weidlein and William A. Hamor; 310 pages, 6 x 9 inches; published by McGraw-Hill Book Co. Inc., New York; and supplied by MACHINE DESIGN for $3.00 plus 15 cents postage.

Of the numerous books arising out of the depression to show that business is studying its problems in an unprecedented fashion, *Science in Action* stands as one of the foremost. Because a large number of progressive manufacturers are making the depression an opportunity for intensive merchandising production and research, there was available to the two authors, identified with the Mellon Institute of Industrial Research, Pittsburgh, a wealth of material for a volume of this type.

The compilation of facts is arranged to give the engineer, scientist and business man a comprehensive picture of the place of science in industry, the means and methods of industrial research, results achieved by various organizations, and important factors in research procedure. The ideas forthcoming from this book reward the reader by assisting him in devising ways and means of correcting the situation of business stagnation. It also will be found helpful to those who are preparing themselves for scientific careers.

Such topics as science, the pilot of technology; industrial research methods and men; and the past and present condition of industrial research, intrigue the reader. They reveal to him a broader concept of the possibilities of earnest endeavor in the laboratory.

MEN OF MACHINES

Personal Glimpses of Engineers, Designers, and Others Whose Activities Influence Design

SELECTED by a distinguished committee of twenty-two members comprising scientists, engineers, educators and industrialists, Dr. Irving Langmuir recently was awarded the $10,000 prize and a gold medal posted by *Popular Science Monthly* as an annual presentation for notable scientific achievement.

As a scientist of outstanding ability Dr. Langmuir is internationally prominent, having invented the nitrogen-filled incandescent electric light bulb. His study of chemistry began when he was seven years old and at 11 years of age he had the elements of a laboratory of his own. In 1903 Dr. Langmuir was graduated from Columbia university with a degree in metallurgical engineering. Upon completing post graduate work at the University of Goettingen, Germany, receiving the degrees of M. A. and Ph. D., he returned to this country and joined the faculty of Stevens Institute of Technology.

Dr. Langmuir's scientific work really began when he became affiliated in 1909 with the research laboratory of the General Electric Co. His discoveries produced vacuum tubes far more powerful and effective than any previously known and made possible the vast development of radio broadcasting. Equally important was his discovery of a new process of electric welding by the atomic hydrogen method. His present title at the laboratory is associate director. Dr. Langmuir was born in Brooklyn, N. Y., Jan. 31, 1881.

"FOR twenty-five years of eminent leadership and administration in the acetylene industry," stated the citation which accompanied the recent award of the Morehead medal to A. Cressy Morrison, secretary of the International Acetylene association. He has been active in every phase of the industry's development, and the sound basis on which it now rests is largely the result of his tireless effort.

Mr. Morrison was born in Wrentham, Mass., Dec. 6, 1864. In June, 1906, he joined the staff of the Union Carbide Co., then having its headquarters in Chicago, and in 1907 was elected secretary of the International Acetylene association. He has seen the uses of acetylene expand from houselighting, which in the beginning was one of the major applications, to the discovery of oxyacetylene and cutting blowpipes.

The activities of Mr. Morrison have not, however, been limited to this particular field; he has been connected with various other scientific movements, holding membership in the council of the New York Academy of Sciences, on the executive board of the National Research council, as expresident of the Compressed Gas Manufacturers association, and as a member of the Royal Institution of Great Britain.

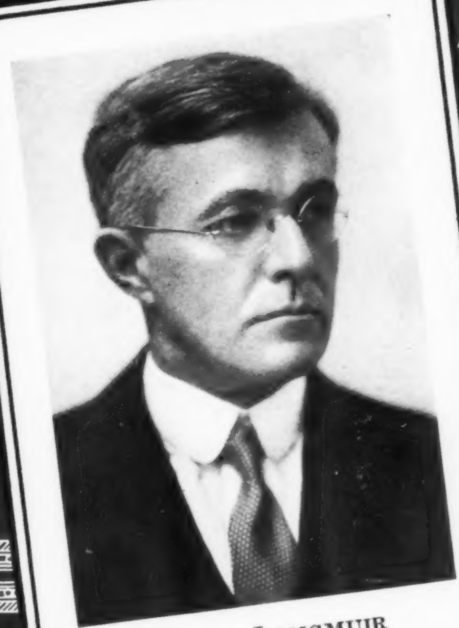
AS THE new president of the Malleable Iron Research institute, Cleveland, E. E. Griest brings to members of that organization the benefit of a diversified background gained through thirty-one years of training and experience in engineering. He is vice president in charge of manufacturing for the Chicago Railway Equipment Co., which is comprised of the Franklin Steel Works, Franklin, Pa., Malleable Iron Works, Marion, Ind., Grand Rapids Malleable Iron Works, Grand Rapids, Mich., and its own plants at Franklin and Chicago.

Mr. Griest was born at Zanesville, O., in 1882. He served as a machinist apprentice, Pennsylvania railroad, Columbus, O., from 1900 to 1904, after which he entered the school of mechanical engineering at Purdue university. After graduation in 1907, he became designing engineer, Crucible Steel Co. of America, Pittsburgh. Leaving that company, he spent some time with the Erie railroad as machine shop foreman, later transferring to the Pennsylvania railroad. Advancing steadily he was made master mechanic in 1915.

It was in 1918 that Mr. Griest became affiliated with the Chicago Railway Equipment Co. He was successively assistant general superintendent and general superintendent until June 15, 1931, the date of his appointment to his present position.

EARLY success of the airship AKRON and the placing of another contract by the government for its sister ship MACON reflects the genius of Dr. Karl Arnstein as a designer of this type of craft. The new ship now is under construction at the airship dock of the Goodyear-Zeppelin

Leaders in Design, Engineering and Research



Irving Langmuir

A. C. Morrison

E. E. Griest

Karl Arnstein

Corp., Akron, O., of which organization he is vice president and chief engineer.

Dr. Arnstein has a notable engineering record. Born in Prague, Bohemia, March 24, 1887, he studied at both universities of Prague and served on the faculty of the technical university before receiving the degree of doctor of technical sciences in 1912. He achieved a reputation for his technique in stress analysis of intricate structures. In 1914 he joined the engineering staff of the Zeppelin company at Friedrichshafen, Germany, devoting his time primarily to the development of fundamental principles in airship design, with particular reference to stress analysis.

In 1924 Dr. Arnstein came to this country and immediately after his arrival in Akron began the task of designing two military rigid airships of 6,500,000 cubic feet capacity for the United States navy, his designs winning first prizes in two competitions conducted by the navy bureau of aeronautics. The contract for the AKRON was awarded in October, 1928, and in 1931 the completed ship was launched.

A number of technical papers have been presented by Dr. Arnstein before American engineering societies, and he is the author of numerous articles on applied mechanics. He is a member of the American Society of Mechanical Engineers, Society of Automotive Engineers, and the sub-committee on airships of the national advisory committee for aeronautics.

* * *

John D. Rauch, formerly chief engineer of the Ohio Power Shovel Co., Lima, O., has been appointed consulting and research engineer. In his new capacity he will devote his attention particularly to research and improvements to excavating and allied machinery in general. Mr. Rauch has contributed several technical articles to MACHINE DESIGN.

* * *

Prof. Henry Louis, secretary of the North England Institute of Mining and Mechanical Engineers and formerly head of the department of mining at Armstrong college, Newcastle, England, has been awarded the Bessemer gold medal of the Iron and Steel Institute, of England.

* * *

Herbert C. Winter has been appointed a member of the research staff of Briggs Mfg. Co. He formerly was project engineer with Stout Engineering Laboratories, specializing in aeronautical research, particularly with reference to all-metal construction.

* * *

Guiseppe Faccioli has been awarded the 1931 Lamme Medal of the American Institute of Electrical Engineers, for his contributions to the development and standardization of high voltage oil-filled bushings, capacitors, lightning arresters, and numerous features in high voltage transformers and power transmission. The medal will be presented at the summer convention of the organization in Cleveland, June 20-24. Mr. Faccioli is a consulting engineer for the General Electric Co.

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Frederick Wille, previously chief engineer of H. A. Brassert & Co., Chicago, has resigned. His successor is A. J. Hulse, formerly assistant chief engineer. C. E. Dougan, chief draftsman, has been appointed assistant chief engineer.

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S. W. Place has become affiliated with the research department of Synthane Corp., Oaks, Pa. He formerly was connected with Atwater-Kent design laboratories.

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R. B. C. Noordwyn, formerly vice president of Bellanca Aircraft Co., New Castle, Del., has become affiliated with Pitcairn Aircraft Inc., as executive engineer.

* * *

M. William Ehrlich, formerly manager at New York for the Trane Co., La Crosse, Wis., is now chief engineer for the Commodore Heaters Corp., New York.

* * *

Howard E. Ames has joined the Marathon Oil Co., Tulsa, Okla. as an engineer in the lubricating oil department, specializing on diesel engines. He was an engineer with Fairbanks-Morse & Co., Chicago, for 12 years.

* * *

Carl D. Taylor, manager of the refrigeration division, Westinghouse Electric & Mfg. Co., Mansfield, O., has resigned that position and been appointed vice president and general manager of the Elin Co., Philadelphia. C. B. Graves, formerly vice president and general manager of Standard Home Utilities Co., Chicago, has been appointed as Mr. Taylor's successor.

* * *

Henry E. Eberhardt, president, Newark Gear Cutting Machine Co., Newark, N. J., recently celebrated his eightieth birthday. He is widely known in the machinery field and in addition to his work in the design of gear cutting machines, has taken out many patents on machine tools and printing machines. Mr. Eberhardt is a director of the American Gear Manufacturers' association.

* * *

William M. Bailey, formerly with the Wireless Specialty Apparatus Co., Boston, recently was made chief engineer of the Dubilier Conden-

ser Corp., New York. For many years he has specialized in condenser design and production problems, making an exhaustive study of mica condensers and their applications at all frequencies even to the ultra-high frequencies now coming into commercial use.

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L. D. Mead has been appointed chief engineer of Divco Detroit Corp. He formerly was designing engineer of trucks and buses at Studebaker and Pierce-Arrow.

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John Seagren has become affiliated with Atlas Imperial Diesel Engine Co., Oakland, Calif., as an engineer in the development and experimental department. He formerly was in the research department of Fairbanks-Morse Co., Beloit, Wis.

* * *

H. H. Morgan, recently assistant chief engineer of the Palmer-Bee Co., Detroit, and prior to that on the engineering staff of Webster Mfg. Co., Chicago, now affiliated with the Weller Mfg. Co., has been made special representative for the Weller company in Detroit.

* * *

George P. Torrence recently was elected president of Link-Belt Co., Chicago. He formerly was vice president in charge of operations at Indianapolis. Mr. Torrence has been affiliated with the company since 1911 when he entered its employ as a sales engineer.

* * *

Dr. Vannevar Bush, professor of electrical engineering at the Massachusetts Institute of Technology, has been appointed vice-president of the institute and dean of engineering as well as a member of the corporation. Dr. Bush is known for his achievements in research and technical education.

* * *

J. Edgar Lee, president of Challenge Machinery Co., Grand Haven, Mich., recently celebrated his fiftieth anniversary in the printing machinery business. He has invented and patented numerous machines and devices for use in the graphic arts.

* * *

D. W. Dean has recently been appointed manager of the control section of the industrial department of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., to succeed the late W. H. MacGillivray. Mr. Dean is recognized as an authority on the design and application of steel mill equipment. Various patents on synchronizing roll table speeds, flying shear control and methods of maintaining tension between stands on tandem mills have been granted to him. His present duties will enable him to expand his activities to include an active part in the standardization of control apparatus.

Obituaries

FREDERICK LANE HUTCHINSON, secretary of the American Institute of Electrical Engineers, died recently at East Orange, N. J., at the age of 65. Mr. Hutchinson was ill for two weeks before the recent Institute's convention but returned for the opening of the meeting. Because of his weakened condition, however, he was unable to stand the strain and suffered a collapse from which pneumonia developed.

Graduated from Cornell university in 1893, Mr. Hutchinson joined the headquarters staff of the American Institute of Electrical Engineers in 1904. In 1908 he became assistant secretary and in 1911 secretary of the organization. Besides his institute membership he was affiliated with the American Association for the Advancement of Science and other societies.

* * *

Hugh Reginald Corse, affiliated with the Lumen Bearing Co., Buffalo, died February 20. He first was employed in the manufacture of rubber goods in Connecticut. In 1910 he joined the sales department of the Lumen Bearing Co. and was connected with this organization until his death, with the exception of the six years between 1914 and 1920, when he was with the Titanium Bronze Co., Niagara Falls, N. Y. His specific work consisted of promoting the sales and use of brass and bronze alloys.

Mr. Corse was active in the automotive circles, having been a member of the Society of Automotive Engineers and an active worker in the committee dealing with nonferrous alloys, particularly those in the cast state.

* * *

John T. Clancy, an executive of Worthington Pump & Machinery Corp., Hamilton, N. J., died suddenly of a heart attack on March 9 while lecturing at the Engineers' Club, New York, before a meeting of the American Society of Mechanical Engineers.

Mr. Clancy was born in New Brunswick, N. J., in 1890. After attending the New Brunswick schools, he studied at Betts Academy, Stamford, Conn., and subsequently at Bowdoin College where he was graduated in 1913, and at Catholic university. He became an instructor in mathematics and chemistry at the Army and Navy school, Washington, and in 1917 entered the army, seeing overseas service as captain of field artillery with the A. E. F. In 1919 he joined the Worthington Pump & Machinery Corp., and four years later became assistant manager of oil and gas engine sales, the position he had held until his death.

TOPICS OF THE MONTH

A Digest of Recent Happenings of Direct Interest to the Design Profession

ARRANGEMENTS had all been completed by the middle of March for the celebration of the moving of the patent office into the new $17,000,000 department of commerce building on April 11. The entire day will be given over to addresses, inspections and festivities.

Just 41 years ago a similar celebration was held to usher in the beginning of the second century of American inventive progress at which Alexander Graham Bell, Dr. Gatling, Eli Whitney, and George Westinghouse were among those present.

While the new offices of the patent office do not contain a great deal more space than the old ones, the new arrangement is much more efficient and modern. It is anticipated that the change will expedite activity in patent procedure.

* * *

Finds That Mechanization Is Not Responsible

THAT modern equipment is not responsible for the present surplus of farm crops is evident from the fact that since 1915, when mechanical power and improved machinery began to be more generally adopted, the production of all crops increased only half as much in ratio to the increase in population as prior to that date. This was the recent finding of Prof. F. A. Pearson of Cornell university. Production of all crops per capita increased only 1.33 per cent a year from 1915 to 1929 as contrasted with 3.03 per cent a year from 1839 to 1914, or before power equipment was used widely, his survey disclosed.

* * *

Soviet Russia Sets Up New Payment Policy

BECAUSE of the policy put into effect in recent weeks by Moscow authorities, a general exodus of American engineers and specialists employed by the soviet government, is noted. This new policy provides for the termination of many individual technical aid contracts that specify large payments in dollars.

In a recent copyrighted Moscow cable to the *New York Herald-Tribune,* it was stated that contracts of this type which have expired are not being renewed, but efforts are being made to persuade some of the specialists to remain under the new type of contract which provides for the payment nominally in dollars or large payments in rubles which are not usable outside the soviet union.

The secret of the new policy is the difficulty which Moscow, due to the world depression, is experiencing in obtaining sufficient dollars to cover its needs. At the rate at which the present policy is working out, the number of technically trained Americans continuing to work there several months hence will be reduced to a handful.

* * *

Cites History of Machine Civilization

BY THE use of machinery the average man in the United States is doing 10 times more work in one-half as much time as were his ancestors in revolutionary days. This was brought out by Congressman Keller, of Ava, Ill., before a subcommittee of the house committee on appropriations. Recalling boyhood days when one brickmaker could produce 2000 bricks in a day, Keller said that today one machine can produce 40,000 bricks in an hour, or as many as 20 men formerly could turn out in a day. Mr. Keller urged the subcommittee to allow the bureau of labor statistics sufficient money to enable it to continue its study of technological unemployment.

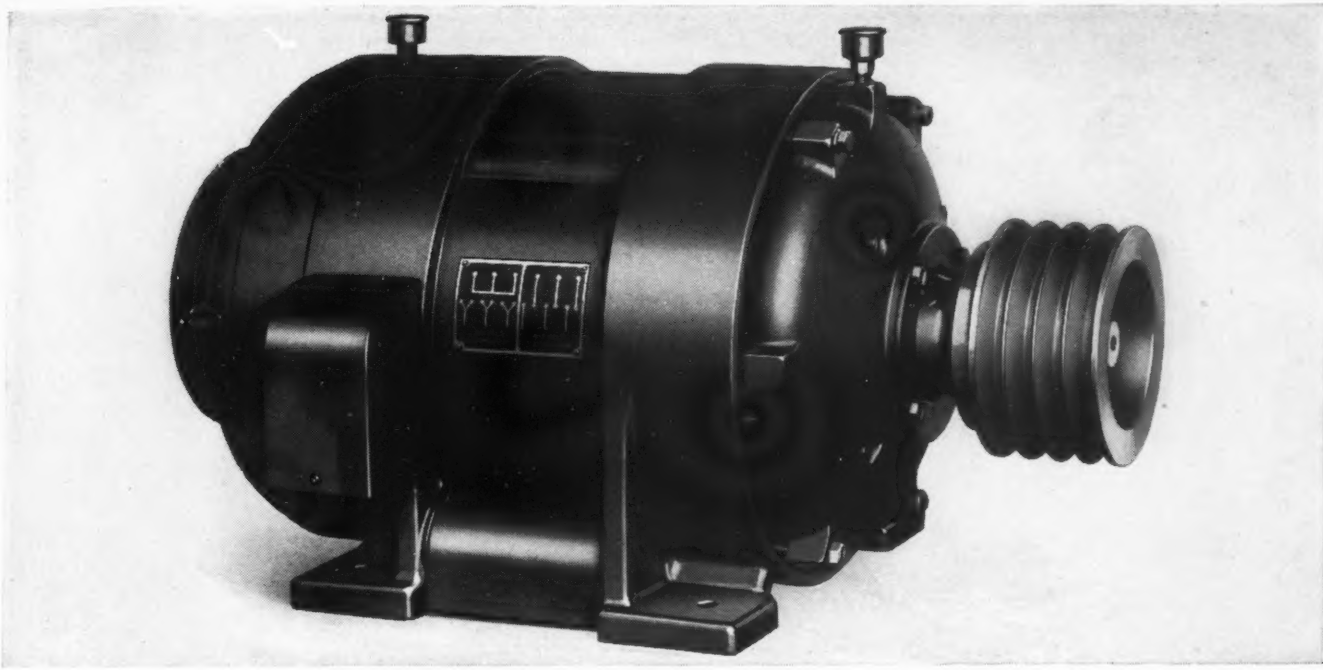
* * *

Conducts Poll on Cause of Depression

ENGINEERS and contractors of Maine have voted that tariffs are a major cause of depressions, according to preliminary results of a poll executed by the Maine employment committee of the American Engineering council, of which Dean Paul Cloke, college of technology, University of Maine, is chairman.

Prohibition and crime were rejected as major depression causes. So also were the Sherman antitrust laws, mechanization of industry, technological unemployment, seasonal unemployment, residual unemployment, accumulation of savings, immigration laws, social standardization, creation of a factory robot class, legal machinery, too much competition, ratio of exports and imports in basic commodities, location of world's gold supply, processes of saving and investing, and production and flow of money.

Seventeen major causes of depressions, besides tariffs, were found, including: Overproduction, cost of government, installation buying, emotion-



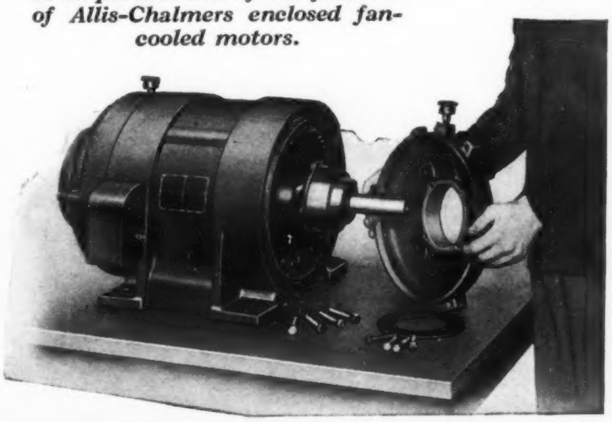
Your Maintenance Man Knows the Value of these Enclosed Motors

HE knows that where dust, dirt, moisture, dripping water, or destructive gases are present . . . . those drives in out of the way places where motor windings become clogged or moisture soaked . . . . there, Allis-Chalmers enclosed fan-cooled motors reduce trouble and operating expense.

He knows that sturdy construction, liberal design, and unexcelled insulation are features of Allis-Chalmers motors and that the enclosed-fan-cooled type, while thoroughly protected, is readily accessible.

Allis - Chalmers enclosed fan - cooled motors approved by the Underwriters for dusty locations are described in Leaflet 2124. Explosion-proof motors, also approved, are described in Leaflet 2125-A.

Complete and ready accessibility to all parts is one of the features of Allis-Chalmers enclosed fan-cooled motors.



Allis-Chalmers Mfg. Co., Milwaukee

ALLIS-CHALMERS MOTORS

al factors in business decisions, promotion schemes, expenditure of national wealth outside the country, buying on margins, speculative purchases and sales, failure of business to create unemployment reserves, and failure to allocate a fair amount of created wealth during periods of excessive profit to workers producing this wealth.

Among the proposals for alleviation or prevention of depression voted worthy of consideration were: Regulation of stock market activities; economic research by scientists and engineers; establishment of research boards; vocational guidance by schools, colleges, and universities; extension of the moratorium from July 1, 1932; industrial, manufacturers' and contractors' associations.

* * *

Standardization Activities More Intense

STANDARDIZATION is probably one of the most widely discussed topics in engineering circles today, particularly because it bears a direct influence on design. Activities to promote standardization are becoming more intensified and practically every field of manufacturing is affected. Of these, the automotive and aircraft industries have been among the leaders in carrying on this work. Proof of this lies in the fact that more than 75 standardization projects are in progress before the various divisions of the Society of Automotive Engineers standards committee.

* * *

User's Satisfaction Is Test of Design

CUSTOMER satisfaction determines in the end just how successful engineers have been in designing their machines. This was impressively brought out by Nicholas Dreystadt, Cadillac Motor Car Co., at the recent joint meeting of members of American Society for Testing Materials in the Detroit district with the Detroit chapters of the Society of Automotive Engineers and American Society for Steel Treating.

With all the experience and care used in designing and manufacturing, the satisfaction that the motor car brings to the individual owner is the final answer as to whether we have been successful, Mr. Dreystadt declared. The consumer is the final judge of the quality of any product. "We find that close co-operation between the engineering and the service departments is the greatest asset that a manufacturer can have because it enables the engineering department to take full advantage of the experiences of all kinds of drivers on all kinds of roads," he said.

* * *

To Study Light Materials and Alloys

AT THE meeting of American Society for Testing Materials committee B-7 on light metals and alloys held recently in Cleveland, three new subcommittees were formed in order to advance the work in this field. The newly formed committees will be responsible for the following projects: Study of proper test bars for light metals; study of the determination of elastic properties of light metals; collection, correlation and dissemination of available engineering data on the physical and mechanical properties of light metals and alloys, and corrosion-resistance properties and protection measures.

It is probable that, after these committees have been functioning for a short time, the work may result in a general symposium on "Light Metals and Alloys." Increasing interest in these materials is evidenced by the repeated demands for technical data of service to the designing engineer.

* * *

Institute Gets da Vinci Collection

INTEREST in Leonardo da Vinci, world famous artist and most eminent engineer of his period, is keen; particularly so at Stevens Institute of Technology which recently was the recipient of a unique collection of books and papers pertaining to his life and work. The gift, valued at about $50,000, was conceived as a memorial to the late John W. Lieb who assembled the documents, and was presented by Samuel Insull, Chicago.

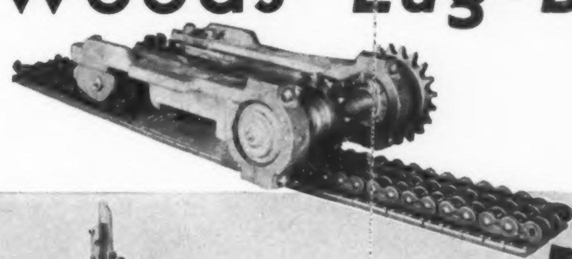
The memorial rooms in which the collection has been placed were provided by a fund given to the college by Wiliam S. Barstow, president of the Association of Edison Pioneers. The collection, from the scholars point of view, is believed to be unrivaled in this country, since it brings together in one place reproductions of all the known Vinciana and documents preserved in various libraries in Europe, especially in Milan, Paris and in the Windsor Castle collection in England.

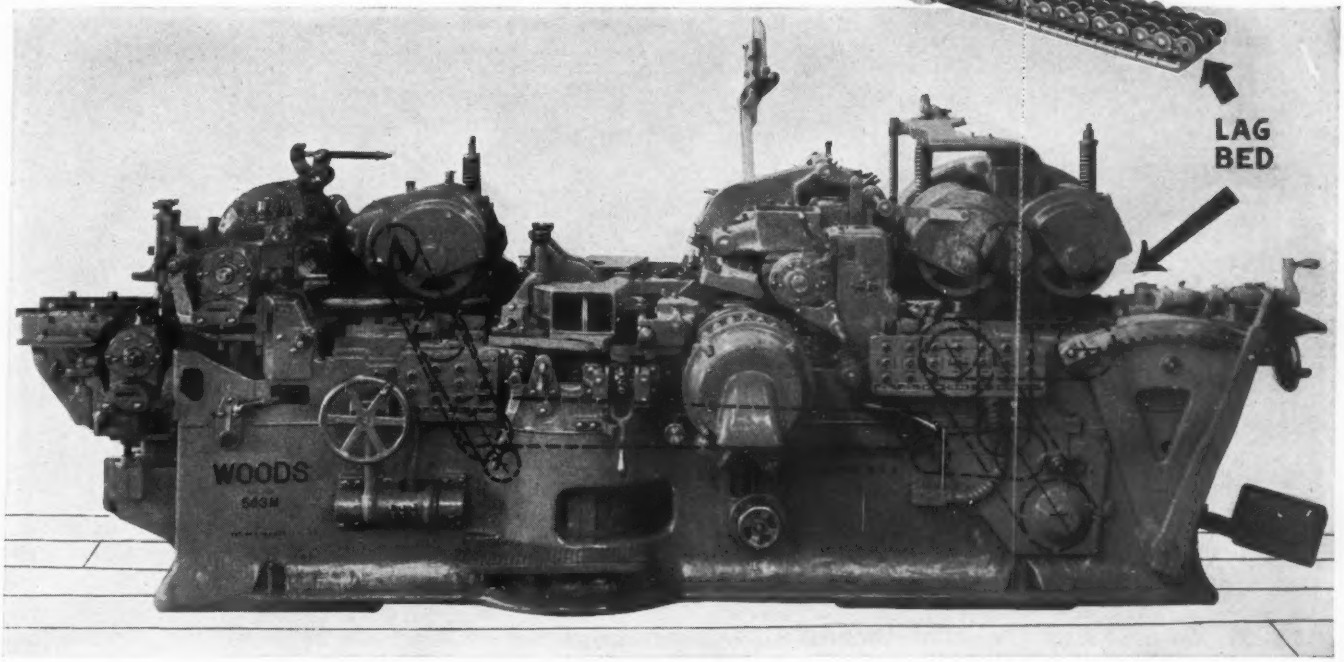
* * *

Changes in Patent Laws Are Expected

HEARINGS lasting several weeks have been held before the house committee on patents of which Representative Sirovich, democrat of New York is chairman, in connection with amendments and changes in the patent laws. As the result of these hearings, Mr. Sirovich has introduced a new copyright bill "to amend and consolidate the acts respecting copyright and to codify and amend common law copyright." Up to the present time the New York congressman has not introduced any new patent bill as the result of the hearings which his committee has held. These hearings indicate, however, that fundamental changes will be made in the present patent laws which measurably will speed up and simplify patent procedure, and that an announcement of the introduction of a bill to accomplish this may be expected at some future date.

Over 60 feet of DIAMOND Chain *on the* Woods *Lag-Bed* Matcher





POSITIVE DRIVE KEEPS ALL UNITS IN PERFECT *AND* PERMANENT SYNCHRONISM

THE Lag-Bed Matcher of the S. A. Woods Machine Co., Boston, is an example of the many superiorities of Diamond Roller Chain as a solution for design and performance problems.

Diamond Chain drives all units positively, and at a permanently correct speed ratio. And because of the roller bearing principle, and of Diamond quality, there is no let-down in speed and efficiency as the years pass.

The use of Diamond Chain removes many limits to design. Units can be located where logic dictates, not necessity, because Diamond runs either over or under sprockets, in either direction, and between short or long centers. It is the most adaptable, and compact per H.P. transmitted of any drive. It is made in capacities and pitches to meet any machine or plant drive up to 600 H.P. and 3600 R.P.M.

Write for the Booklet 104A *"Simplifying and Improving Machine Design."* It cites many problems solved by the adaptability of Diamond Roller Chain.

DIAMOND CHAIN & MFG. COMPANY
435 Kentucky Avenue Indianapolis, Indiana
Offices and Distributors in Principal Cities

DIAMOND ◇ DRIVES

for **Every Industrial Need**

Quiet — Clean — More Compact per H. P. Transmitted

This Diamond on every link identifies the Diamond Drive

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Gentlemen: Please send me a copy of Booklet 104-A *"Simplifying and Improving Machine Design."*

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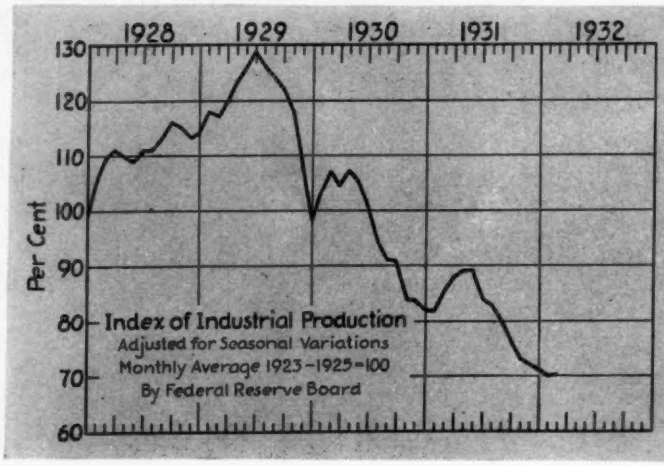
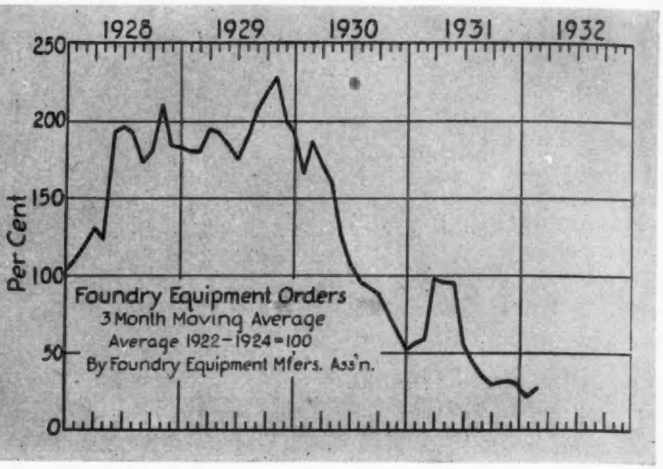


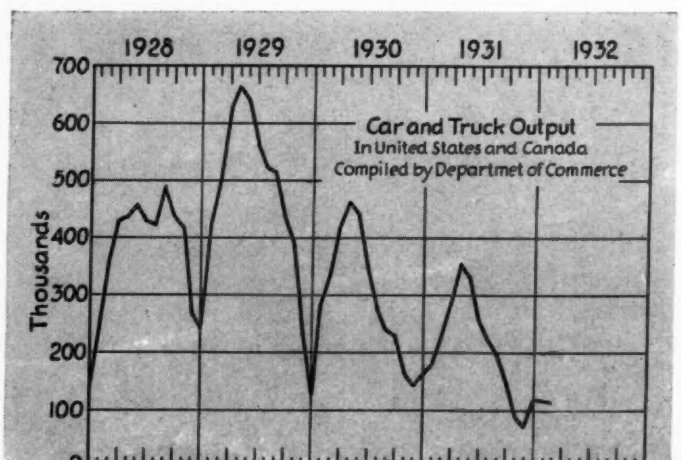


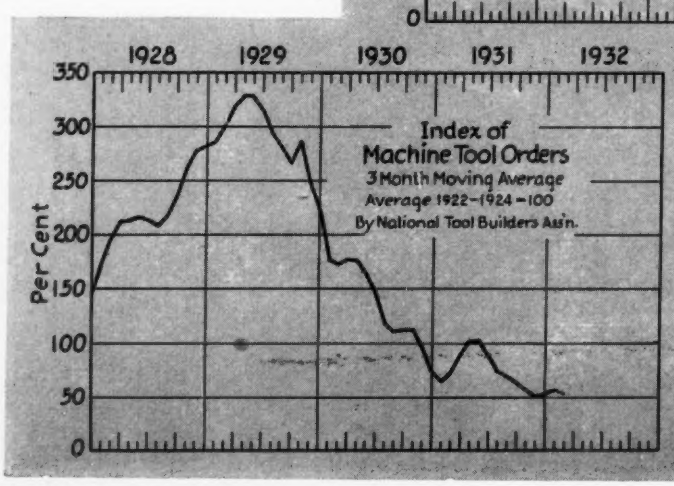
How Is Business?

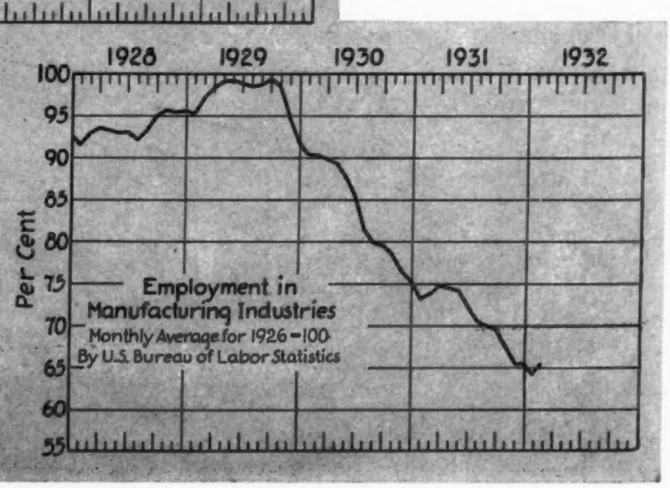
REFLECTING the usual trend at this time of the year, employment in manufacturing industries registered a gain, but the encouraging factor in this gain is not its presence but its amount. The increase shown is the largest made in any one month since February, 1929, although an almost equal advance was shown in March, 1929.

It is expected that the advance registered in employment will be continued through March, thus duplicating the favorable development first registered at this time last year. By the first of January, 1931, the abnormal industrial production experienced from September, 1924, through November, 1929, had been balanced by the subnormal production from that time until January, 1931. Every indication was that production would increase steadily until the normal trend line had been reached.

However, it was not realized at the time that the financial and credit situation would develop fright among the bankers and start the downward slide anew. Since that time the financial situation has improved materially, various steps taken by Congress bolstering the entire financial world and supplying a sedative to their nerves that is expected to remove the last obstacle to continued improvement. The present outlook is considerably more encouraging than that faced a year ago. If the possible rate of recovery of industrial production follows the rate registered in 1921-22, the normal trend will be reached in 1934.







NOTEWORTHY PATENTS

A Monthly Digest of Recently Patented Machines, Parts and Materials Pertaining to Design

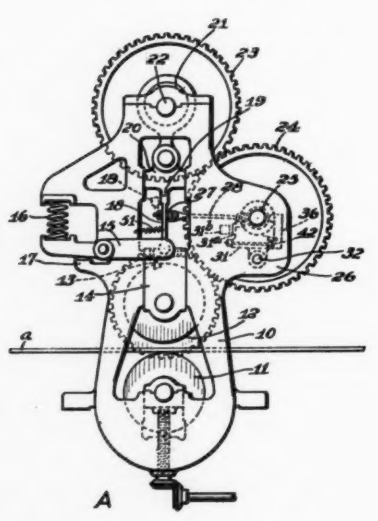
CHOOSING simple mechanical parts, F. C. Biggert Jr. has designed a clutch of the one-revolution type for establishing a connection between elements of a machine, releasing the connection after a revolution has taken place. A patent, designated No. 1,846,179, recently was issued for the mechanism, with the United Engineering and Foundry Co., Pittsburgh, assignee.

The clutch is shown embodied in a flying cutter, Fig. 1 for placing in operation the shearing members employed to sever strip material while in motion. Side elevation *A* depicts the arrangement of this particular type of machine in which block 14 is depressed against the action of spring 16 so that blade 13 will engage anvil roll 11 to cut the strip *a*. When gag plate 18 is in the position shown in full lines at *A*, abutment 19 during the downward movement of the cross head 20 will engage it and cause block 14 to be forced downward.

If the gag plate 18 is in the dotted line position it is out of the path of the abutment 19, during which block 14 remains in its upper position and is not affected by reciprocations of cross head 20. The patent covers the clutch controlling the operation of this gag plate which is connected by link 28 to the actuating mechanism shown at *B* and *C*. The end of the link opposite that to which the gag plate is secured is provided with a cam contactor 29, being pivoted between ears 30 formed in the upper end of an actuating lever 31, designed to rock on shaft 32.

Cam contactor 29 co-operates with a cam 33 on countershaft 25, the rise 34 operating to rock the actuating lever 31 in a counterclockwise direction and cause link 28 to push the gag plate 18 from its full line into dotted line position, the extent of the movement being limited by an abutment 31*a* on the actuating lever with a stop 31*b* secured to a fixed part of the machine. Fig. 1, *C*, shows the design of lever 31 to accommodate rock shaft 35 which carries armature lever 36. This armature lever has a cam contactor 37 co-operating with cam 38 mounted on shaft 25 beside cam 34. Cam 38 has a low portion 39, and incline 40 and a concentric portion 41. When the low portion 39 is opposite contactor 37, armature lever 36 can be swung from the dotted into full line position shown at *B*. Subsequently, as the countershaft 25 rotates in the direction of the arrow, the contactor will ride up the incline 40, thereby swinging actuating lever 31 in a clockwise direction, causing link 28 to pull gag plate 18 from its dotted line into full line or operative position.

Armature lever 36 is held normally in dotted line position, Fig. 1, *B*, by a torsion spring 42 coiled between it and actuating lever 31, as shown at *C*. An electromagnet, the energization of which is controlled by movement of strip *a*, is mounted so that one pole 44 is opposite armature lever 36. When the magnet is energized



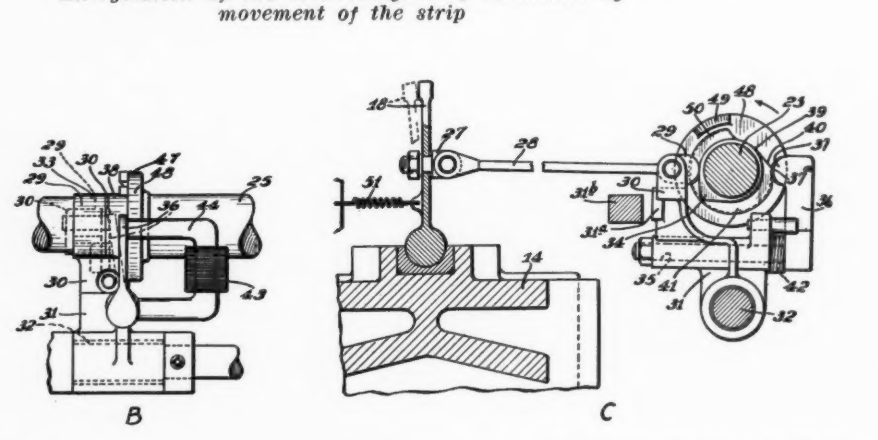


Fig. 1—Flying cutter embodying the clutch mechanism is shown at A. The arrangement of cams, the gag plate and the electromagnet in views B and C co-operate to effect the cutting of strip material. Energization of the electromagnet is controlled by movement of the strip

the armature lever will be drawn, if the position of the high portion 41 of the cam 38 permits, from dotted line into operative position.

In order to insure that contactor 37 of armature 36 will be moved out of operative relation with cam 38 at each revolution of countershaft 25 when the end of the high portion 41 is reached, a face cam 47 is mounted on countershaft 25 adjacent cam 38. It is formed with a projection 49 adapted to engage armature lever 36 just before low portion 39 of cam 38 comes opposite contactor 37. Cam projection 49 definitely pushes the armature lever 36 from full line to the dotted line position as shown in Fig. 1, *B*. The armature lever then is held there by torsion spring 42.

TO ELIMINATE the necessity for a battery of spray nozzles, C. E. Scott has devised an arrangement whereby rotating disks are used to distribute particles of moisture in air conditioning apparatus. Patent No. 1,848,202 has been ascribed to the invention, of which United States Blower & Heater Corp., Minneapolis, is assignee.

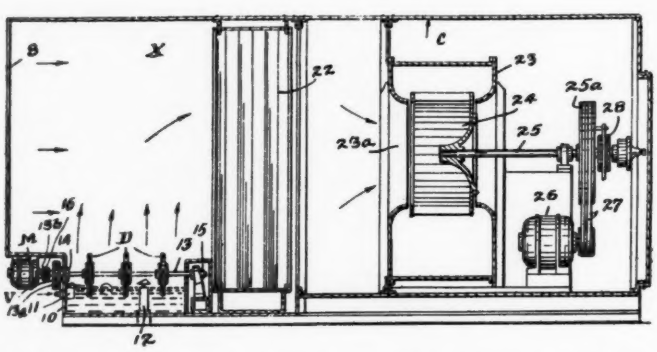


Fig. 2—Arrangement of parts including moisture distributing disks D, in the interior of air conditioning apparatus

The interior of the air conditioner revealing the arrangement of the parts is shown in Fig. 2. In Fig. 3*A* is presented a diagrammatical view showing the air conditioning chamber of the unit in cross section to illustrate the action of the moisture distributing elements. The construction of one of the distributing disks may be seen at *B*, Fig. 3. Each element comprises a relatively thin disk 17 which may be constructed of noncorrosive material such as aluminum. Fine mesh netting or metal screen is secured to the two faces of each disk. Edges 19*a* are successively overlapped.

When looking at the moisture distributing elements *D* from the intake end of the casing, Fig. 3*A*, the right hand series of elements will be revolved in a clockwise direction, and the left hand in an anticlockwise. They are immersed in the water in tank 10 at a depth less than the width of netting 19. Each disk in rotation picks up small particles of liquid between the meshes of the netting. Capillary attraction and surface tension tend to retain the liquid within the meshes and between the outer surfaces of the screen and adjacent face of the disk until centrifugal force throws it off in a fine spray. From the illustration it will be seen that the particles of moisture are discharged by the disks in the direction of the center of the air treating section and also upwardly, completely filling the chamber.

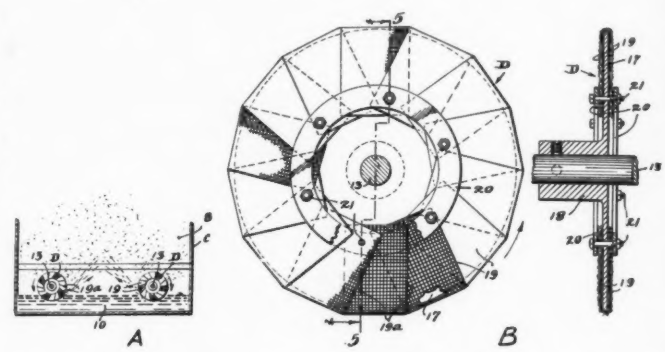


Fig. 3—Diagrammatical view A illustrates action of moisture as distributed by rotary disks. B shows construction of disk

IMPROVEMENT in oil retention construction for ball bearings is covered by a patent granted recently to George O. Hodge and assigned to Standard Steel & Bearings Inc., division of Marlin-Rockwell Corp., Plainville, Conn. The patent number is 1,839,677. Fig. 4 shows three sectional views. In that depicted by *A*, the rotating contact surface or face 14 is part of inner ring 11; *B* shows seat 18 as part of the inner ring 19, being of plain cylindrical form without any shoulder; in the structure, *C*, Fig. 4, the seat 20 is provided by the supporting shaft 21, the inner ring 22 terminating adjacent seat 20.

The oil retainer or seal is composed of two circular plates, 23 and 24, wedged together into a groove in the outer ring 10 of the bearing. Between these two plates is a wiper or ring of felt 26 that makes contact with the inner ring

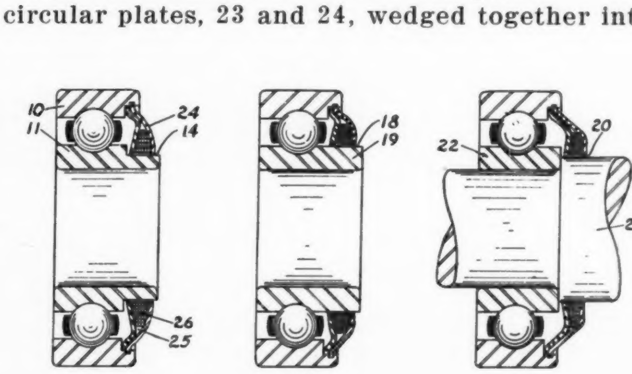
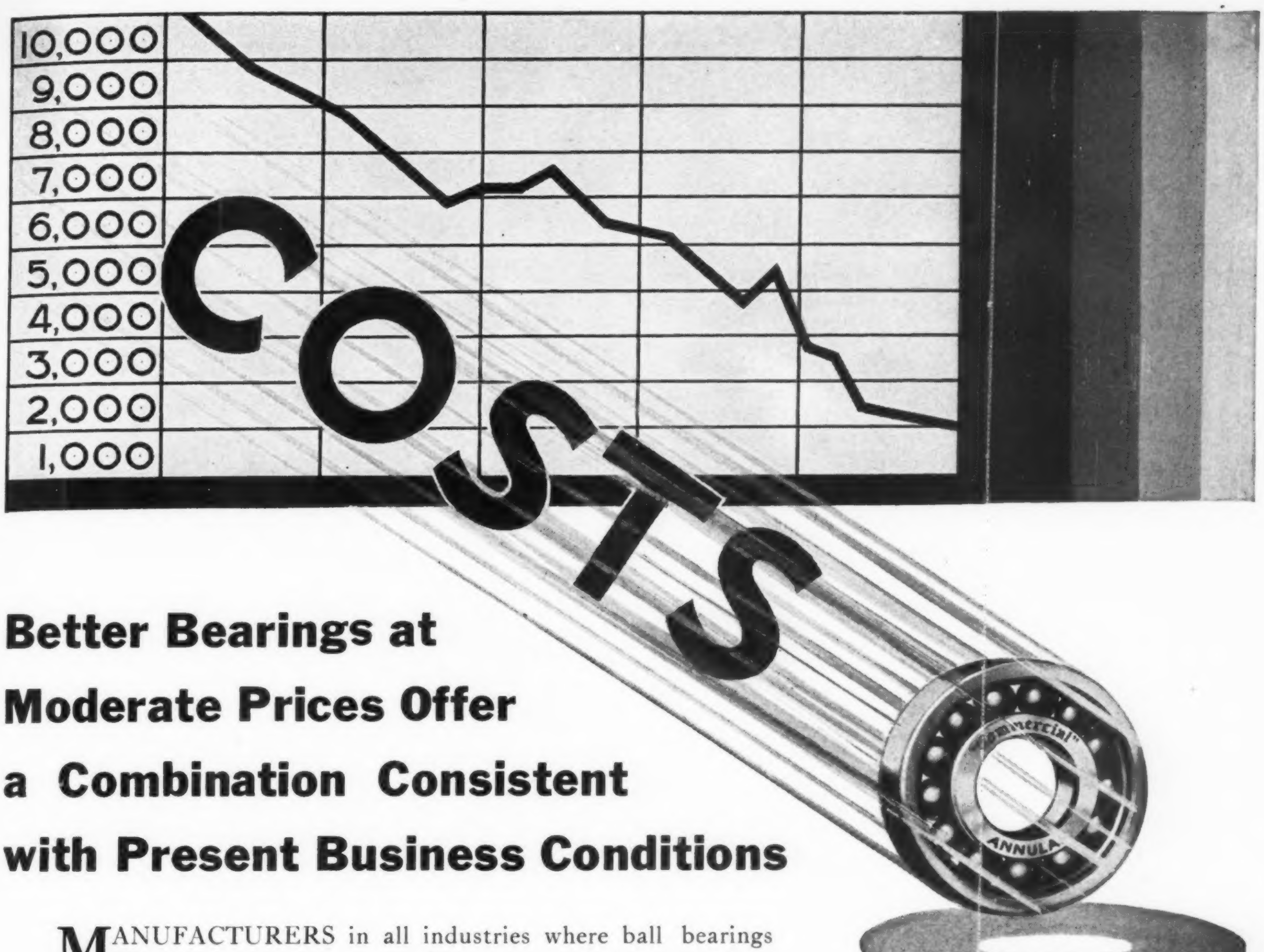


Fig. 4—Three sectional views showing oil retention construction for ball bearings. Two plates with felt between comprise seal

(*Concluded on Page* 76)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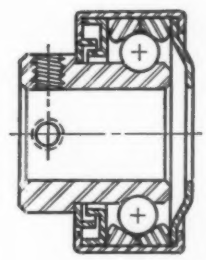


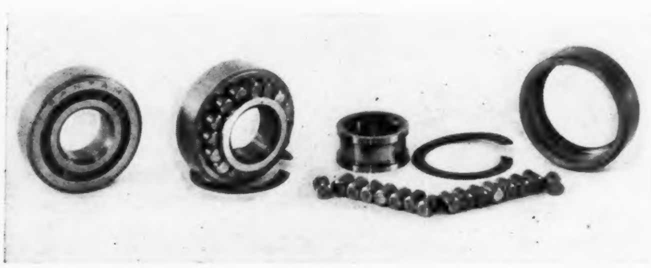
NEW MATERIALS AND PARTS

Worthy of Note by Those Engaged in the Design of Mechanisms or Machines

Introduces Radial Roller Bearings

RADIAL roller bearings having a full complement of rollers have been brought out by Bantam Ball Bearing Co., South Bend, Ind., in the standard ball bearing metric sizes which allow complete interchangeability. These bearings, shown herewith, have two lips on the inner ring or cone, and one lip on the outer ring or cup, which allow this type of bearing to take thrust loads in one direction.

Due to their large radial capacity, this type is particularly adaptable to applications where the design will not lend itself to a larger bearing and where a larger load capacity than that of a conventional bearing is desirable, such as electric motors, machine tools, pumps, grinders and speed reducers.



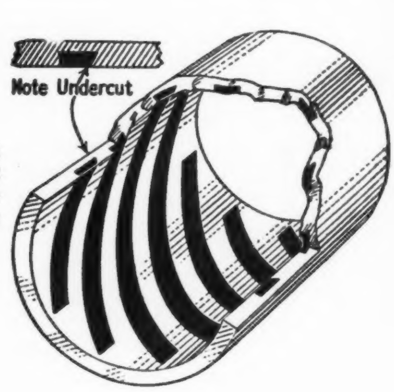
Disassembled view of new radial roller bearings which have a full complement of rollers

High carbon alloy steel is used for both the races and rollers. Size and run-out tolerances are the same as for a ball bearing of equivalent size, and as specified by the Society of Automotive Engineers.

Graphite Reservoirs Lubricate Bearing

SPIRAL-TYPE oilless bearings designed particularly for sliding, oscillating, vertical, horizontal motion and full revolution speeds up to 2500 revolutions per minute depending on load are a recent development of E. A. Williams & Son Inc., 111 Plymouth street, Jersey City, N. J. The bearings, shown herewith, are made from bronze cast in sand molds.

These parts are lubricated by graphite filled reservoirs, which are machined in. The reservoirs are so placed in the bearing that lubrication takes place under all motions, no matter how small. The grooves are machined with an undercut which insures retention of graphite, and are arranged so as to provide thorough lubrication with sacrifice of only a minimum amount of bearing surface.



Grooves machined with an undercut and filled with graphite lubricate this type of oilless bearing

The allowance on the bore of these bearings should be from 0.001 to 0.002 greater than for plain bronze bearings as reaming the bore after the bearings are installed is not recommended by the manufacturer.

Alloy Steel Is Fabricated Easily

CORROSION-RESISTING alloy steel, known as Nevastain RA, of a straight-chromium type and containing copper and silicon developed by Ludlum Steel Co. is being marketed by Associated Alloy Steel Co., Cleveland. The material was developed as a result of research aimed to perfect a corrosion-resisting steel which could be mill processed and handled by the fabricator with the same tools, furnaces and heat treatments that are general practice practice in fabricating mild steel.

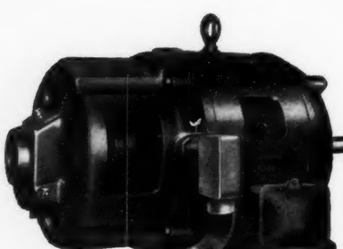
Maximum carbon content is 0.10 per cent;

maximum phosphorous and sulphur, 0.03. Other elements are present in approximately the following proportions: Manganese, 0.40; chromium, 16; silicon, 1; and copper, 1 per cent. The steel machines almost as easily as the high-sulphur types of alloys, and can be sheared, punched, perforated, sawed and drilled by ordinary methods. It can be gas or electric arc, flash or spot welded without tendency toward grain growth. A high permanent luster of a blue-white color is obtainable by polishing.

The new material is magnetic and does not work-harden to the same extent as the other stainless alloys, it is said, and therefore can be cold rolled, drawn, upset and formed with facility. High temperature heat treatment for annealing or to relieve forging or drawing strains is not required, full ductility being obtained at normal annealing temperatures (1500 degrees Fahr.). However, when required, higher strength and hardness can be obtained by heat treatment, in which the steel is heated uniformly to 1700-1750 degrees Fahr., quenched in water or oil and then drawn to requirements, generally 1000-1200 degrees Fahr.

New Vertical Motors Are Announced

THE line of slip ring motors manufactured by Century Electric Co., St. Louis, has been extended from 20 horsepower to 250 horsepower,



Line of slip ring motors has been extended from 20 to 250 horsepower. It now includes motors from ¼ to 250 horsepower

1800 revolutions per minute, 60 cycle. Features and advantages of the previous motors will be included in this new line, which now covers motors from ¼ to 250 horsepower, one is shown in the accompanying illustration.

Lubricator Is Entirely Automatic

ELIMINATION of the human element from oiling is possible with a new automatic force feed lubricator, Model 25, for automatically lubricating the bearings of industrial machinery, recently developed by Manzel Brothers Co., Buffalo. With this system there is an independent oil line to each point to be lubricated; each bearing receiving just the right amount of oil. The lubricator is placed on the frame of the machine on which it is to be used and is connected to some movable part, either by reciprocating or rotary motion. An oil line runs to each bearing, the feed being adjusted according to the amount of oil required by the particular bearing lubricated.

Lubricator is placed on the frame of the machine and so connected to a moving part that a regulated supply of lubricant is furnished regularly

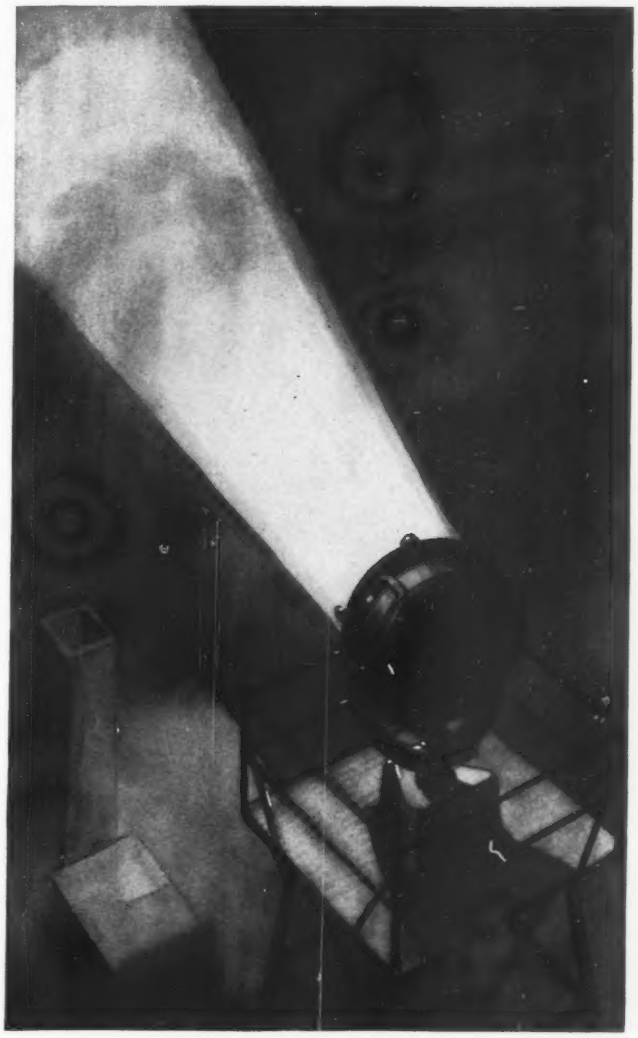
An important feature of this lubricator, shown herewith, is the accessibility of the working parts, each unit being independently removable without stopping the machine on which it is installed, or without interfering with any other unit.

A suitable size and style of lubricator is built for practically every type of machine. They can be supplied with from one to 30 feeds, with either rotary or ratchet drive and with different reservoir capacities. For high speed machines requiring small amounts of oil, lubricators with special reduced drives can be supplied, the reductions varying from 37½ to 1 up to 3600 to 1; while for extremely slow moving machinery, direct acting lubricators delivering oil at every stroke of the driving lever are available.

Synthetic Material Dampens Vibration

COMBINING unusual compliance and damping, the new synthetic product known as Keldur now being manufactured in this country by Keldur Corp., 26 Avenue B, Newark, N. J., offers exceptional properties that may be applied to the smothering of vibration. The material resembles an extremely soft rubber that will not bounce but returns to shape slowly. It is permanent under all ordinary conditions. It is, for example, absolutely unaffected by oils. Long exposure to water has some affect on the

Piercing the Fog



Night after night it sweeps star-flecked skies to point the way. Smiling pilots nod to its friendly flash . . . and wing on into the night secure and comfortably confident of their course.

But there are other nights. Nights that prove the air beacon more than a passing incident. Nights when all other landmarks are befogged and meaningless. When ITS *flash alone says—"Straight ahead . . . you're safe."*

• • •

WHEREVER they go, men set up markers to guide their travel. Thus machinery buyers for years have used Motor Control as a guide in motor and machinery selection. Cutler-Hammer Motor Control, they have found, invariably marks good equipment.

In the busy days of pressing production activity, hurried executives merely nodded to the familiar C-H trademark on the Motor Control and proceeded with confidence. But *now* they seek for it as never before. Today, in the fog of wild claims and price selling, it serves when all other landmarks are blurred or lost. It *still* points the way to dependable machines, low maintenance costs, fruitful investments.

Any machinery builder knows that modern machines must be complete—ready to use. They must be engineered as an operating unit with a suitable motor and proven Motor Control. No Motor Control can add more to a machine's performance than Cutler-Hammer. None can add so much to its saleability. CUTLER-HAMMER, Inc., *Pioneer Manufacturers of Electric Control Apparatus,* 1310 St. Paul Ave., Milwaukee, Wisc.

CUTLER HAMMER

C-H

The Control Equipment Good Electric Motors Deserve

A-631

material, and it cannot be used without protection in locations where it would be kept wet much of the time.

The product is designed for the full atmospheric range of temperatures but is not recommended above 140 degrees Fahr. It should not be loaded much above 30 pounds per square inch and should be loaded usually to at least 10 pounds per square inch. As it is practically incompressible volumetrically, Keldur should not be used in large unbroken pressure areas. It is so yielding or compliant that one 3/8-inch thickness is usually enough to isolate any but extremely low periods of high energy. The material is available at present in sheets, fabric faced, 1/4, 3/8 and 1/2-inch thick, up to 3 feet square. The 3/8-inch thickness is the one usually employed.

Extends Line of Slip Ring Motors

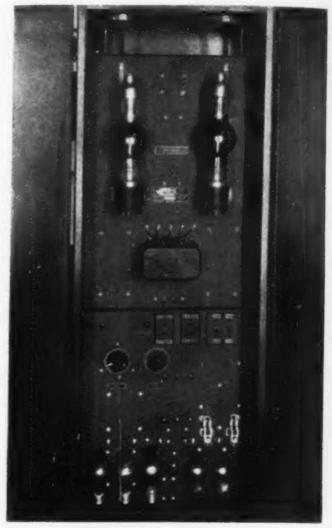
TYPE R direct current motors for vertical operation designed to meet the many requirements imposed on this style motor have been introduced by Century Electric Co., St. Louis. The motors, shown herewith, are ball

Direct current motors for vertical operation are designed to meet all requirements of this type

bearing, grease-lubricated, and can be mounted on a ring base or directly on the driven equipment as required. The top bearing bracket is protected with a cover and may be furnished with open or with screen or solid covers to meet surrounding conditions. The motors are built in sizes from 1 to 150 horsepower.

Thyratron Tubes Control Welders

CLOSE and accurate control of the frequency of current interruption in line welding, and an increase in speed of interruption up to 1800 per minute, are among the advantages of a new type of Thyratron tube timing control announced by General Electric Co., Schenectady, N. Y. The new control, shown herewith, replaces mechanical interrupters. The equipment operates in synchronism with the alternating current supply of the welding machine. The weld is always started at a predetermined point in the voltage wave and stopped when the current passes



Control equipment for automatic welding machines operates in synchronism with the alternating current supply of the machine, giving close and accurate control

through zero. Thus the period of current application can be controlled accurately even with "on" times of but one or two cycles.

The control embodies a series transformer the primary of which is connected in series with the primary of the welding transformer and the secondary of which is short circuited by two Thyratron tubes connected thereto. Welding current will not flow unless the grids of these tubes are energized properly. For controlling and energizing the grids of the tubes three small Thyratron tubes are used. One in connection with a condenser acts as a timer. This timer trips when the condenser is charged to a certain point and controls the grids of the other two small tubes which, in turn, control the two power tubes. The control has no moving parts and is subject to no such wear as is involved in mechanical interrupters.

The new synchronous tube timer supplements, and is designed to work in conjunction with the type CR 7503 welding control of the company which uses Thryratron tubes instead of contactors for interrupting the flow of current.

Clutch Has Serrated Contact Faces

TO MEET the requirement of an absolutely fixed clutch without the danger of creeping of clutch contact faces which would defeat the "tie in" purpose, Dings Magnetic Separator Co., Milwaukee, has developed a magnetic clutch-coupling having serrated contact faces. This clutch-coupling when energized will not creep

Here are some IMPROVED METHODS in motor building!

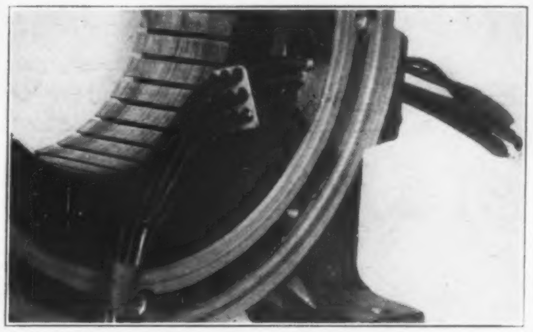
F-M TYPE Q
BALL BEARING
MOTOR

Certainly, a motor must come up to *electrical* specifications. But don't forget that a motor is an apparatus for converting electrical energy into *mechanical power*. And it's in the mechanical design and construction where you will find the biggest difference between one make of motor and another.

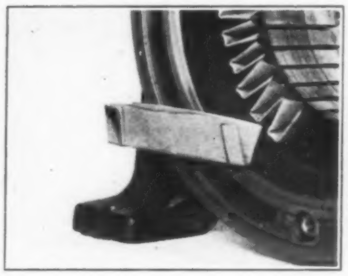
Fairbanks-Morse Motors meet the most exacting electrical specifications. But with characteristic thoroughness, Fairbanks-Morse has achieved a position of leadership in *mechanical* design and construction of motors.

In the column at the right are a few of the new, unusual methods which are employed to make Fairbanks-Morse Type Q Motors give longer, trouble-free service. The complete story of this extra value in motors will be sent on request.

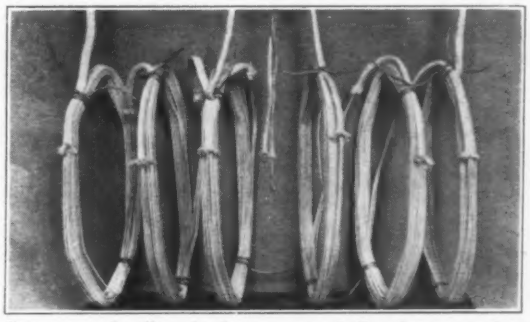
FAIRBANKS,
MORSE & CO.
900 S. Wabash Ave. Chicago



Sealed-in leads. Through an opening in the frame—and there anchored permanently with a special sealing compound. The roughest kind of service during installation or afterward cannot put strain on the field connections.

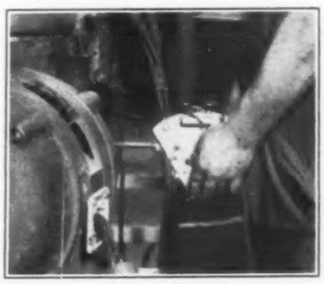


Special cuff insulation. Empire cloth inside of two special pre-formed fibrous sheets is inserted in the stator-core slots. An ingenious method of folding makes self-locking cuff and gives permanent protection from slippage and gives added protection to the windings.



Group wound coils. A phase group winding from one piece of wire—reduces stub connections and eliminates a source of mechanical failure. Lead connections from these phase windings are *welded*, not soldered or brazed. An innovation in field construction that keeps motors out of the repair shop.

Every motor is given a thorough vibrometer test to make sure of proper dynamic balance. Eliminate vibration and you reduce to a minimum the wear on bearings. Sealed-ball bearings and smooth running insure trouble-free service from F-M Motors under severest operating conditions.



FAIRBANKS-MORSE
motors

POWER . PUMPING . AND . WEIGHING . EQUIPMENT

5659-EA40.44

and adjustments will remain fixed within the torque limits of the clutch.

The contact face serrations are V-toothed in character, 3 degree pitch and developed on a cone. There is the same tooth depth over the face with consequent uniform engagement when magnet element is energized and armature element attracted to it.

Due to the character of this clutch-coupling construction, it is made to suit installation conditions and because of the high torque capacity the physical dimensions are less than those of a friction type clutch. The field of use is any application where synchronization of speed of two power drives is required.

Announces Rugged Watertight Starter

A COMPACT and rugged alternating current manual starter, class 2510 W6, of water and dust tight construction has been announced by the industrial controller division, Square D Co., 710 South Third street, Milwaukee. The three pole starter, shown herewith, is designed

Three pole starter is designed to control across-the-line single and polyphase motors of two horsepower or less. It is of water and dust tight construction.

to control across-the-line single and polyphase motors of 2 horsepower and less. It is suited particularly to packing plant, creamery, flour mill, cement plant, foundry and similar applications where extreme moisture and dust conditions are encountered.

In addition to the water and dust tight construction, other outstanding features are push button operation, and compactness obtained without sacrificing wiring space. Overload protection is provided by time limit overload relays which are front reset and require no replacement of parts after operation. Tripping of either relay opens all three lines. Approximate dimensions are 4¾ inches wide 8¾ inches high and 6 inches deep.

Noteworthy Patents

(*Concluded from Page 68*)

11 of the bearings shown at *A* and *B*, or with shaft 21 as in *C*. The felt wiper or ring forms an oil stop or dam that retains the lubricant within the bearing.

Plate construction and assembly are such that there is a constant pressure against the felt ring between the plate members. This pressure tends constantly to force the felt ring against the rotating inner ring or shaft so as to improve the sealing contact and to take up wiper wear as it develops.

Review of Noteworthy Patents

Other patents pertaining to design are briefly described as follows:

CRUSHER—1,851,109. Assigned to Smith Engineering Works, Milwaukee, a patent recently was issued for a crusher comprising a frame, a pair of stationary jaws, and a pair of movable crusher jaws, the upper ends of which have resilient supporting connection with the drive shaft.

LOCK WASHER—1,850,242. Shakeproof Lock Washer Co., Chicago, has obtained a patent for a lock washer corrugated to provide radially extending alternate ridges and furrows. Teeth on the washer are twisted, certain of the diagonal corners of each projecting above and below the top and bottom of the corrugations.

SPRING MOTOR—1,851,066. This patent covers a spring motor with a front and rear frame plate, each having a turned projecting edge. Pillars hold the frames together with the projecting edges facing each other. A cover shield is positioned in the edges with means for locking it in position. Assigned to Western Clock Co., Peru, Ill.

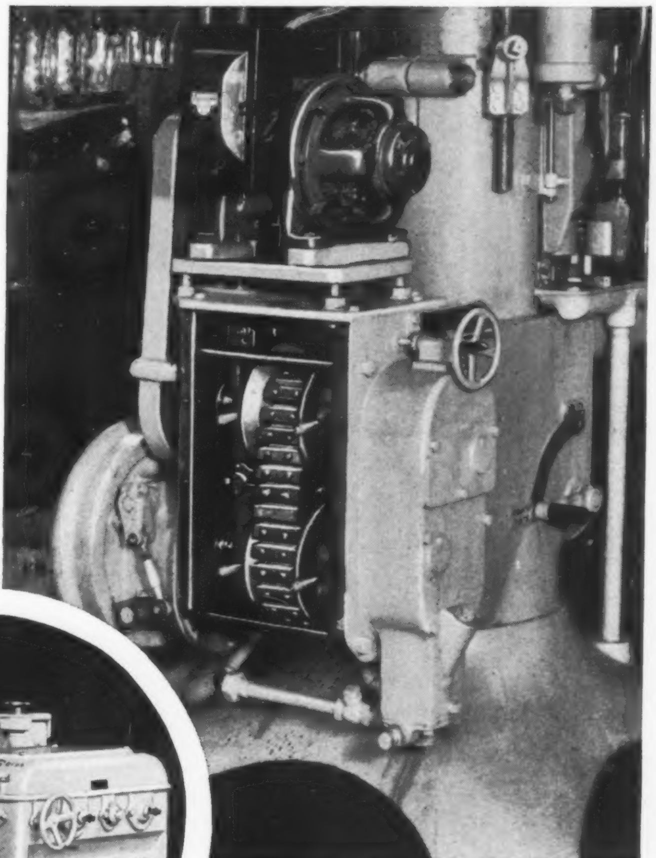
ANTIFRICTION BEARING AND SEAL—1,850,170. This patent covers a bearing comprising an inner race ring, an outer race ring and a row of rolling elements between the rings, a sealing device carried by one end of the bearing to close the space between the outer and inner race rings, and a sealing device carried by the other end of the bearing for sealing the outer race ring in a bearing seat. Assigned to New Departure Mfg. Co., Bristol, Conn.

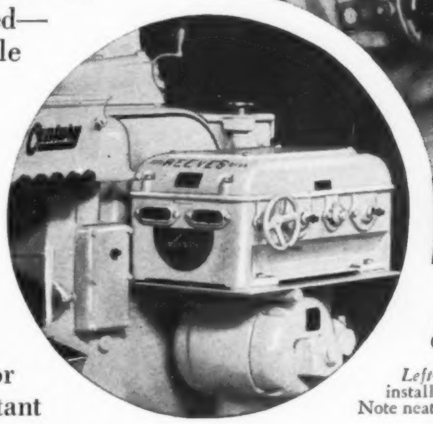
PISTON PACKING--1,851,108. Patent covers a piston packing comprising two split rings, each having an overlapping joint in which the plane of overlap intersects the side faces only of the ring. One of the rings contains an annular groove in one side face, and the other a corresponding annular tongue co-acting with the groove. The rings are free to rotate individually. Assigned to American Hammered Piston Ring Co., Baltimore.

COIN-CONTROLLED MECHANISM — 1,850,382. A coin-controlled mechanism comprising a casing having a coin insertion opening, a pair of pivoted plates disposed in the casing adjacent the wall of the casing, a rockable member carried by one plate, extending through the plates and provided with projecting elements in the path of movement of an object inserted in the opening. Assigned to Cornine-Hakanson Die Casting Co., New York City.

• Give Your DESIGN IMPROVEMENTS Added SALES POWER

• by Providing COMPLETE SPEED ADJUSTABILITY





Above—Internal Operating Mechanism of REEVES Transmission is incorporated in enclosed housing in base of this Automatic Filling and Capping Machine. (Cover removed in illustration.)

Left—REEVES Horizontal Enclosed Design Transmission installed on modern Dough Divider as standard equipment. Note neatness and compactness of installation.

• CAN YOUR MACHINES buck competition this year with the handicap of a single fixed operating speed—or a few meager steps in speed? Now—while making other changes to improve performance—add the important factor of *complete* speed adjustability. Give your machines an infinite number of speeds over the complete range needed—as provided by the REEVES Variable Speed Transmission.

When a machine is REEVES-equipped, that machine can be operated at exactly the speed required for any changing condition in production—variances in materials, in sizes and types of products, in quantities and quality of products, in temperature, in skill of operators. Guesswork is eliminated. Loss of time, labor and materials is prevented. Important savings are effected IMMEDIATELY. These are vital sales advantages to build into your machines these days!

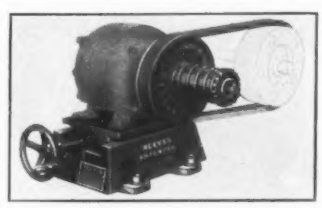
You will find REEVES engineers skilled in helping you apply the REEVES Transmission compactly and efficiently. The internal operating mechanism may be incorporated right into the frame of your machines; or the Transmission, complete in its own frame, may be used. An extensive range of sizes, designs and controls to meet each specific requirement. More than 670 machinery builders already have adopted the REEVES. Write for the new REEVES Catalog H-99, full of practical suggestions.

REEVES PULLEY COMPANY, *Columbus, Indiana*

REEVES

Variable Speed Transmission

NEW SPEED CONTROL UNIT FOR SMALL H. P. DRIVES



FOR FRACTIONAL to $7\frac{1}{2}$ H. P. drives, requiring not more than 3:1 range of speed variation, the new REEVES Vari-Speed Motor Pulley provides accurate speed adjustability. Can be used with any constant speed motor—either A. C. or D. C. Special V-disc pulley mounts directly on standard extension of motor shaft. Driven pulley may be any acceptable type of flat-belt pulley. This simple, compact, low-cost unit is exactly what many machine manufacturers require to provide their product with speed flexibility. . . . Write for full information, and copy of descriptive Bulletin V-100.

MANUFACTURERS' PUBLICATIONS

Publications listed in this section may be obtained by engineers responsible for design from the manufacturers of the products or through MACHINE DESIGN

ALLOYS (GENERAL)—Illium, a nonferrous corrosion resistant alloy, composed of nickel, chromium, copper, molybdenum, tungsten and other elements, is presented in an attractive booklet prepared by Burgess-Parr Co., Moline, Ill. This alloy has withstood the action of acids, alkalies and organic substances, and is easy to weld, grind, polish or machine. It has a tensile strength of 60,000 pounds per square inch, elastic limit of 50,000, specific gravity 8.3, and brinell hardness 170-200.

ALLOYS (NICKEL)—International Nickel Co., New York, has prepared the 1932 issue of its "Buyers Guide" listing the sources of supply for finished parts made of nickel and of the alloys themselves.

ALLOYS (STEEL)—Associated Alloy Steel Co. Inc., Cleveland, presents in a recent bulletin its new alloy Nevastain RA, developed as a result of research aimed to perfect a corrosion-resisting steel which could be mill processed and handled by the fabricator with the same tools and heat treatments that are general practice with mild steels. The attractive booklet gives methods of fabrication and treatment, engineering data, and applications.

BEARINGS—All latest sizes of radial thrust roller bearings manufactured by Shafer Bearing Corp., Chicago, are listed in a recent bulletin, No. 501, of the company. The bulletin contains complete dimensions and list prices with speed factor table for figuring intermittent loads. Both single and double row bearings are covered.

BEARINGS—Spiral-type oilless bearings which have graphite-filled reservoirs machined in are covered by a recent pamphlet of E. A. Williams & Son Inc., Jersey City, N. J. The grooves are machined with an undercut which insures retention of the graphite. The bearings themselves are made from bronze cast in sand molds.

BEARINGS—Spadone Machine Co. Inc., New York, has prepared a booklet describing Metaline Oilless bearings. After machining to standard size or to the user's specifications, holes are drilled into the bearing wall to receive the lubricant. Metaline, a compounded material solidified in cylindrical plug form in steel molds under pressure, is inserted into the drilled holes in the bearing wall and anchored.

COUPLINGS—Flexible couplings of simple construction, comprising two sprockets and a length of roller chain, are described in catalog 11 of Diamond Chain & Mfg. Co., Indianapolis. The 20-page catalog points out the sturdy construction features and ease of installation and disconnection of the couplings, illustrates and tabulates all the types and sizes in the line and gives data on selection and installation.

DRIVES—Silent chain and sprockets manufactured by The Whitney Mfg. Co., Hartford, Conn., are the subject of catalog V-100 recently published by the company. The catalog includes extensive information on the design of silent chain drives and the selection of sprockets. Other material treated includes: Advantages of silent chain drive for positive power transmission, description of the double bearing pin and bushing type chain, dimensions, and a description of an automatic chain take-up.

GEARS—Complete general information on spiral bevel gears including their history, advantages, physical properties, method of cutting, mounting, application, practical points on design, and formulas for computing value of axial thrust are included in a recent bulletin of Gleason Works, Rochester, N. Y.

LUBRICATING EQUIPMENT—Lubriplate Corp., New York, has issued two booklets describing its new metal-depositing lubricant. The lubricant provides smooth bearing surfaces by depositing a minutely thin film of zinc on parts under pressure. It prevents rust and corrosion and will not oxidize under high speeds and temperatures.

LUBRICATING EQUIPMENT—Force feed lubricators for positive and automatic lubrication of cylinders and bearings are described in catalog No. 31 of Manzel Brothers Co., Buffalo, N. Y. The lubricators have an individual pumping unit for each point to be lubricated. While so arranged that all working and moving parts are inside of the reservoir where they are constantly immersed in oil, any unit may be removed in two or three minutes time without stopping the equipment.

MOTORS—Ohio Electric Mfg. Co., Cleveland, has issued bulletin No. 211 which illustrates special motor designs which have been built by the company. The bulletin shows drawings of special frame designs, and gives dimensions and horsepowers.

MOTORS—Wagner Electric Corp., St. Louis, has issued a new 22-page bulletin, No. 174, on squirrel cage motors. The bulletin describes the seven types of squirrel cage motors made by the company, gives application tables, speed torque curves, complete construction details and similar information.

STAMPINGS—Geometric Stamping Co., Cleveland, has prepared an excellent metal stamping reference book which gives in concise form standard practice design, engineering data and factors of economy in metal stampings. Included in the book are elements of design as influenced by materials of construction, shape of machine parts for strength, factors of design favoring low cost stampings and similar information. Copies of the 28-page book will be sent to anyone requesting it on company letterhead and mentioning the source of their information.

Business and Sales Briefs

R. W. POWELL is now in charge of the Cleveland branch office of Fafnir Bearing Co., New Britain, Conn. This office has been removed to Room 407 Union building, 1836 Euclid avenue. In New York city, Fafnir products are being distributed by L. C. Biglow Co., 250 West Fifty-fourth street. Branch office removals include the Detroit branch to Room 502 New Center building, and the Los Angeles branch to 417 West Pico street.

* * *

Lumen Bearing Co., Buffalo, has purchased the plant equipment, supplies, patents, etc., of Buffalo Bronze Die Cast Corp., producers of bronze and brass castings. The equipment of the two companies will be combined.

* * *

R. E. McGill, Pacific Coast district manager for Aluminum Industries Inc., Cincinnati, is in charge of the new warehouse opened by the company at 86 North Twelfth street, Portland, Oreg.

* * *

B-B Nut Co., Philadelphia, recently acquired the sole licenses for United States, Canada, and Mexico of all patents of the Safety Nut Corp., Philadelphia.

* * *

Offices of the American Gear Manufacturers' association have been removed to 308 Ninth-Vincent building, Cleveland. T. W. Owen continues as secretary of the association.

* * *

American Screw Co., Providence, R. I., and Western Screw Mfg. Co., Chicago, have been licensed by Dardelet Threadlock Corp., to manufacture and sell bolts, nuts and screws threaded with self-locking thread.

* * *

Horsburgh & Scott Co., Cleveland, manufacturers of industrial gears and speed reducers has opened a district sales office at 844 Rush street, Chicago. Representatives at this office are H. G. Davis, C. R. Morrison and R. W. Hoyt.

* * *

Reliance Electric & Engineering Co., Cleveland, manufacturers of alternating and direct current motors, has established a sales branch at 703 Bona Allen building, Atlanta, Ga., in charge of Marshall Whitman and George Gardner. This office will cover North and South Carolina and Georgia.

* * *

Patent rights for the production of magnesium alloys controlled by Aluminum Co of America and the German I. G. Farben-Industrie A. G. will be taken over by Magnesium Development Co., a combination of the two previously mentioned organizations with the board of directors comprising representatives of both participating companies. Special attention will be devoted to the manufacture of the I. G. alloy Elektron.

* * *

Diamond Chain & Mfg. Co., Indianapolis, manufacturers of roller chains, sprockets and flexible couplings, recently appointed West coast representatives as follows: Puget Sound Machinery Depot representatives in Oregon and Washington with stocks carried at Klamath Falls and Portland, Oreg., and Hoquiam and Seattle, Wash.; Joseph D. Christian Engineers, San Francisco, engineering representatives, and Horsford Brothers Co., San Francisco, industrial distributors, for Northern California; and Goddard Jackson Co. representatives in Los Angeles.

Index To Advertisers

MACHINE DESIGN is a monthly technical publication conceived, edited and directed expressly for those executives and engineers responsible for the creation and improvement of machines built for sale, and for the selection of the materials and parts to be used.